The Electrical World.

Vol. XXIII. NEW YORK, MARCH 24, 1894. No. 12.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

41 PARK ROW (TIMES BUILDING), NEW YORK.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

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THE ELECTRICAL WORLD,

41 Park Row, New York.

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CHANGES IN OUR DIGEST.

The number of articles which a complete record of current foreign electrical literature must notice has become so great that some of the abstracts in the Digest often become quite short in consequence; much interesting and useful information in these abstracts is thereby crowded out, making the record more like a mere index, which would be of much less value than a true digest. In order to be able to devote more space to these abstracts, certain references will hereafter be omitted, as explained in a note in this issue, and we trust that the readers of the Digest will agree with us that the usefulness of this department will be increased by making these unimportant omissions.

LICENSEES OF PATENTS.

The recent memorandum handed down by Judge Lacombe defines the right of users in licensed territory in regard to a patented article bought from other than the licensee of such territory. In the present instance the Imperial Hotel, which had been enjoined from using other than Edison lamps, purchased such lamps from dealers outside of New York, and the Judge decided that in view of the defendant's claim of ignorance of the restrictions under which the sellers were not to dispose of lamps in licensed territory, the motion for punishment for contempt of court was denied. The memorandum quotes the proposition that once lawfully made and sold, there is no restriction on the use of a patented article in favor of the patentee or his licensees, and points out that a patentee who wishes to divide his rights territorially is dependent upon the good faith of those to whom he sells. He may protect himself either by selling his lamps only to persons on whose honesty and responsibility he can rely, or require from them sufficient security for damages through failure to keep faith, and cannot charge the purchaser with knowledge of agreements made with those from whom he buys lamps. The effect of this decision would seem to be likely to curtail still more the dearly bought privileges of the Edison licensees.

JUDGE RICKS' OPINION.

The opinion of Judge Ricks in the case of the Universal Electric Company contains two points of great interest. In the first place, it narrows the opinion in the Buckeye case to the point that the Buckeye company had obtained vested rights by investments made when it was generally thought, and with good reason, that the Edison patent was invalid; that its grounds were further strengthened by knowledge of the endorsement of the Edison attorneys on the Edison lamp patent, limiting its life to November, 1893, and by acquiescence in its sale and manufacture of lamps even after Judge Wallace's decision. All of this placed it in the light of a company that had made investments in good faith and consequently one that could not be made to suffer by the subsequent revocation of an act upon which it with reason had relied. The other point is in the concluding portion of the opinion, where the judge refers to two contentions of the plaintiff which, he apparently goes out of his way to remark, "might be of very great importance in connection with the case if presented in a different phase." These are, that the endorsement of December, 1883, was entirely void for want of jurisdiction of the Patent Commissioner, and the record, not one of which the public were obliged to take notice; and that it was not binding on the complainant, for

the reason that its license antedated the endorsement, and therefore could not be affected by proceedings in the Patent Office of which the licensees had no notice.

THE PRACTICAL PROPERTIES OF POLYPHASED APPARATUS.

In this issue we give the concluding portion of Dr. Bell's Institute paper on polyphased apparatus, which is undoubtedly the most important contribution on the practical side of the subject that has yet been made. In the present section the questions of frequency are discussed from various standpoints, and while it will be seen that special considerations largely enter in the choice of the number of frequencies, yet there seems to be little reason for going above 60, and to go below 30 is pronounced a wanton disregard for the most characteristic advantages of the alternating system. The remarks on static capacity are timely, as this subject and the effects of resonance do not seem to have received the attention their practical importance warrants. As to the saving of copper with different alternating systems, that depends upon the basis of comparison. If the effective E. M. F. is taken, then the results of the author are approximately correct, the saving in the interlinked two and three phased systems over the simple alternating system being 27.1 and 25 per cent. respectively. If, however, we consider the stress on the insulation, which would appear to be the only true criterion, then, while the saving of the interlinked, three-phased system would remain 25 per cent., the two-phased system, with three equal wires, would require 50 per cent. more copper than the simple alternating system, or 45.7 per cent. more with the same density of current in all three of the wires, one being 1.4 times larger than either of the others. The author calls attention to the absurdity of comparing the copper efficiency of direct and alternating currents not only because they are not competitiors in practice, but also on account of the unknown but probably considerable weight of the electrolysis factor in the former case.

AN IMPORTANT PATENT CASE.

The celebrated Bate refrigerator case has at last been argued before a court of final jurisdiction and the decision will be awaited with much interest in electrical circles. Should the court conclude to reverse former decisions and decide that the language of the Revised Statutes shall be interpreted not according to their meaning, but according to the supposed intent of the framers of the original law, a new field of litigation will be opened up that seems to be boundless in extent. As to the case at issue, among the important effects of a reversal will be to prolong the life of the Edison lamp patent to 1897, extend the life of the Edison carbon telephone patent, and similarly affect important patents in every branch of the electrical industries. Among other questions dealt with in the arguments is the intent of our patent policy as regards the public and inventors. Mr. Peckham in his argument held that patent legislation is not class legislation, not primarily for the benefit of the inventor, but for the benefit of the public, and the Constitution and Supreme Court are quoted as authorities. A patent, it is stated, is given, not to reward merit or as a bounty, but as a compensation to secure a public benefit upon just terms, which shall recognize and protect the inventor's property in his invention by giving him a monopoly therein in return for its disclosure, but shall also protect the public against exorbitant demands by limiting that monopoly to a fixed and uniform term, that is deemed adequate to furnish a proper compensation. It is argued that there is no injustice to a patentee in restricting the life of his American monopoly, which is the only one that can be reached, when he is at the same time enjoying further compensation from other countries. It is also held that if the construction asked for is granted three objects which the law now subserves will be defeated: First, to cause an invention patented here and abroad to be free to the public here as soon as it is free abroad; second, to promote the earlier introduction of the patented invention in this country; third, to secure some allowance to the American public on account of the further monopoly enjoyed in foreign countries. It is also claimed that the change would delay the issue of the American patent until after all of the foreign patents were secured, and thus plainly nullify the spirit of our patent laws. On the other hand, the counsel for the appellants claim that the construction they ask for is in conformity with reason and justice. That an applicant for an American patent who has satisfied every requirement of diligence and promptitude in making his application, and thus entitled himself to a patent for his invention for the full term of seventeen years, should, be subjected, in consequence of something thereafter happening over which he has no control, to the penalty of having his patent abridged for a period,it may be, of many years, and even, as possible, of losing it altogether, is they maintain, repugnant to every sentiment of justice. This view is elaborated throughout the argument and seems to have been met with difficulty by the other side, who apparently rely more upon the previous decisions sustaining their point and upon their contention against going behind a statute to change the plain meaning of its words.

GERMAN SERIOUSNESS.

Under the heading "Another Startling Discovery" in our issue of Feb. 3 we published a little amusing filler from a German paper not thinking for a moment that any one would believe we meant seriously that it was what the title claimed, or that there was a shadow of truth in the statement. We thought that the language we used would suffice to show our opinion of the absurd claims, and we are therefore greatly surprised, and a little discouraged, to find that a leading German contemporary—we have too much respect for it to mention its name here—credits us with really believing this absurdity. For the benefit of its editor and other Germans who may have had the same unfortunate impression, we state here in plain terms—and we mean it seriously this time—that our knowledge of electricity leads us to believe that that inventor is mistaken—to put it mildly. It appears that this clipping has, like most of its kind, gone the rounds of the press, and as it was published also in this German journal, its editor asks us to kindly state the name of the "German journal whose title leads one to believe that it is a scientific paper"—evidently believing that we meant his journal. We regret not being able to give the source, but are pleased to assure him that it was not his journal, which we esteem very highly, even though its editor failed to grasp our attempt at ridiculing. It reminds us of a saying that "Germans must club together to understand a joke." Acknowledging our humiliation, we promise to try to do better, and hereafter when we are not serious we will adopt the English plan and explain in parentheses exactly where the point of the joke lies, what the joke really is, and what it would have been if there had been no intention of being sarcastic, etc.—at least when it is intended for our German friends. We admit that this is a safe rule even though Americans would rather not try and say anything amusing if they have to do it in that extremely thorough way.

Honesty the Best Policy.

It is the policy of some English journals to give little or no credit to America for what it has done, even though the editors must sometimes think the contrary—if they are reasonable and if they read anything outside of their own paper. It is therefore very refreshing to find the following in such a high-class journal as "Industries and Iron." In referring to the Niagara Falls plant it says: "America is the raising ground for able, fearless and persevering practical men suitable for dealing with such problems as these."

A. E. Kennelly.

Among the electricians of the younger generation there are very few to whom it has been granted to have given to the world so much that is of permanent value as has Mr. Kennelly. His investigations have included many branches of electricity, and in each one his work now forms an integral and important part of the structure of the science. The Kennelly law of copper exposure resistance has rendered the localization of faults on cables, in most cases, a comparatively simple matter. The Kennelly law connecting ferric reluctivity with intensity of magnetizing force is destined to be of the greatest importance when it becomes necessary, as it soon will, to take into account more precisely the secondary effects of iron in alternating current circuits. His results on the heating of conductors in air, in conduits, underground and submerged in water, have become classical, and form the basis of nearly all the tables now in use. The introduction, due to him, of complex quantities into alternate current equations is a mathematical advance of the first order, of what importance may be seen from Mr. Steinmetz's paper on the subject, and from Mr. Kennelly's further application of it, in conjunction with hyperbolic functions, to the solution of the very complicated phenomena of flow in circuits having leakage, capacity and self-induction, in addition to resistance. By a recent application of the latter methods he has raised telephony from an empirical to an exact science.

Mr. Kennelly was born in Bombay, Dec. 17, 1861. It is from his father, at that time commander of a frigate in the East India Navy, that Mr. Kennelly has inherited in large part his well-known mathematical ability. He left India at an early age for the purpose of receiving an education in Europe, and finally entered the University College School, London.

While at this institution, in 1875, his attention was turned to electricity by a lecture of Mr. Latimer Clark on telegraphy, and on leaving University College School, in 1876, he became assistant secretary at the office and Ronalds Library of the Institute of Electrical Engineers (then the Society of Telegraph Engineers).

As a result of his studies at the Ronalds Library, he was enabled to enter the service of the Eastern Telegraph Company in 1877, and from thence onward promotion was rapid. In 1880 he became assistant electrician on board the steamship John Pender, and in 1881 became chief electrician on board the same vessel. Later he served in the same capacity on several other vessels in the company's service, and was employed in work over all parts of the Eastern Telegraph Company's submarine cable system.

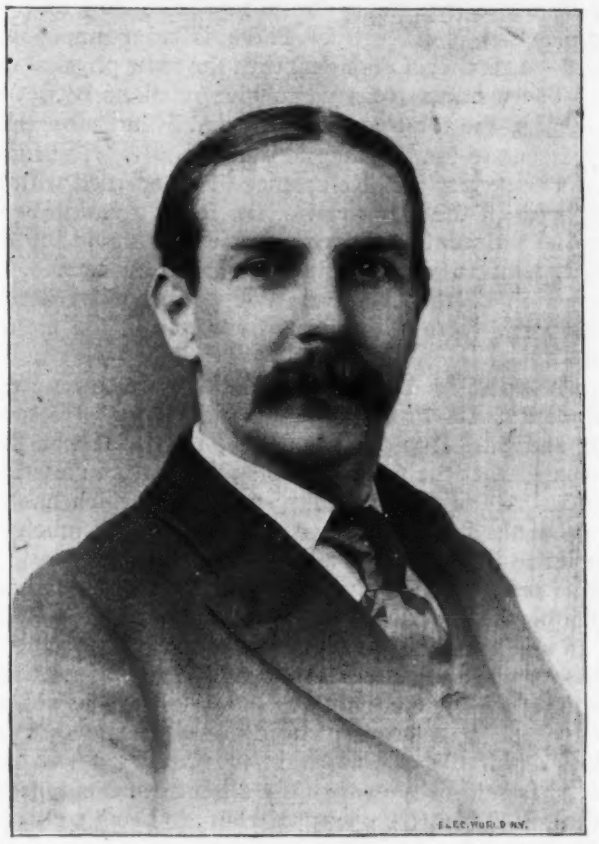
It was during this period that he discovered the law of fault resistance known by his name, and which is now so much employed in cable testing, and in 1887 he published a paper on the subject which received the "Society's premium" for that year.

Other methods originated by Mr. Kennelly about the same time were the method of fault localization (a combination of Clark's method with the Wheatstone bridge), given in Jamieson's pocket book, pages 167-168, and, in conjunction with Mr. James Anderson, of what is known as the "earth-overlap" test.

In 1888, while senior electrician afloat of the Eastern Telegraph Company, he resigned his position to accept that of electrician to Mr. Edison, then just commencing work in his new laboratory at Orange, and was shortly afterward appointed consulting electrician to the Edison General Electric Company and later to the General Electric Company. He has recently left Mr. Edison's laboratory to enter upon electrial engineering work in Philadelphia with Prof. Houston, under the firm name of Houston & Kennelly.

Mr. Kennelly is a vice president of the American Institute of Electrical Engineers, and chairman of the committee on units and standards of the same body. He is also a member of the New York Mathematical Society, of the Astronomical Society of the Pacific, an associate member of the Institute of Electrical Engineers of London, and a fellow of the Royal Astronomical Society.

Mr. Kennelly's work, as the readers of the technical journals are aware, has covered a wide field. Owing to his connection with the Edison company, necessarily but a small portion of his work in electrical engineering has been published. Through the courtesy of that company, however, his experiments on the heating of electrical conductors have been given to us. The first of the papers on this subject was read before the Association of the Edison Illuminating Companies in 1889, and upon the results contained in it, as mentioned above, almost all the tables at present in use have been based. The treatment of the subject was completed last year by a second one[1] on the carrying capacity



A. E. KENNELLY.

of cables underground and submerged in water, and this latter paper bids fair to be as valuable as the former.

Mr. Kennelly's discovery of the law of resistance of an exposure of a conductor to salt water and his other work on the localization of faults have already been referred to. They are generally considered to be among the most important contributions to that subject.

For the reason given most of his published work has been in a purely scientific line. A considerable number of laboratory methods are due to him, among others a method of measuring mutual induction, which appeared in The Electrical World Oct. 5, 1889; a magnetic bridge, described in the same paper,[2] and which is probably the most convenient and accurate way at present known of rapidly making permeability tests; a method of measuring the temperature coefficient of copper,[3] which formed the subject of a paper read (in conjunction with Prof. Reginald A. Fessenden) at the Electrical Congress at Chicago, and a number of other

[1] The Electrical World, Sept. 2, 1893.
[2] The Electrical World, Sept. 9, 1893.
[3] The Electrical World, Oct. 7, 1893.

methods which have from time to time been published in the electrical papers.

Among the more important instruments designed by him may be mentioned the differential dynamometer wattmeter, an instrument by which, the primary of a transformer being suitably connected to one set of coils, and the secondary to the other set, the losses in the transformer at any load may be read directly from the instrument; a static voltmeter[4] now in use in street railway stations, and which overcomes the difficulties met with in other forms of the instrument; and the ammeter[5] bearing his name, which are made by the Edison Manufacturing Company.

Among the papers dealing with theoretical subjects is that on "Reluctance," read before the American Institute of Electrical Engineers (October, 1891), in which the law connecting ferric reluctivity with intensity of magnetizing force was first stated. In passing, it may be pointed out that the statement made by some authorities (e. g., Prof. S. P. Thompson, "Dynamo Machinery," page 169) that this law may be derived from the hyperbolic formulae of Stoletow and other experimenters, is incorrect. There is no connection between them, as they do not deal with the same physical quantities. The formulae referred to give relations between the reciprocal of the total permeability and $\mathfrak{H}$, and are approximately accurate for low magnetizations only. The formula given in the paper on "Reluctance" is concerned with a relation between the reciprocal of the ferric permeability and $\mathfrak{H}$, and experimental evidence shows that it holds up to the highest point to which saturation has been carried. The introduction of the ideas of ferric permeability, ferric reluctivity, etc., form an important advance in the theory of magnetism.

Other papers read before the Institute are those on "Inductance and Its Proposed Unit, the Henry" (December, 1890), and on "Impedance" (April, 1893). It was in this latter paper that the use of complex quantities in alternating equations was first proposed, a suggestion which has given to us a method of dealing with such equations much more powerful and simple than we possessed before.

Other recent papers give for the first time the methods of calculating the drop on long lines carrying high potentials[6] and an application of the same method to the problems of telephony,[7] which enables us to calculate very approximately what the efficiency and behavior of any given line will be.

One of the most striking features of Mr. Kennelly's papers is their admirable clearness. If true art, as a well-known painter has said, is shown in the absence of the appearance of effort, then his papers may lay claim to being truly artistic productions. In the latter papers mentioned, for instance, so simply and lucidly is the subject dealt with, that not every one would suspect that the formulae employed were really a transformation of some of Oliver Heaviside's most unmanageable equations into a form in which they can be used by every electrical engineer to work out the most complicated problem of alternate current circuits.

Mr. Kennelly is the author of two books. One, "Practical Notes for Electrical Students," written in conjunction with Mr. Wilkinson, and a later one, "The Theoretical Elements of Electro-Dynamic Machinery," in which the subject is dealt with, in a great many cases, from an entirely new standpoint, so that one turns the last page with the realization of the fact that his views have been greatly broadened, and that what one had supposed to be a more or less complete conception of the subject, was in reality but an incomplete and one-sided view.

Mr. Kennelly's work as the chairman of the committee of units and standards is well known, as also his work as a member, in conjunction with Mr. Carl Hering and Prof. Anthony, on the Institute programme for the Chicago Congress. One result of his labors in the latter connection was the extension to him and to Mr. Carl Hering of a special invitation to attend the meetings of the official delegates to the congress, and although all the plans of the committee were not carried through by that body, there is little doubt but that in the end most of them will be accomplished.

The appreciation in which the work of Mr. Kennelly is held by those exceptionally competent to judge was illustrated recently at the last meeting of the National Electric Light Association. Prof. Forbes, in the course of some remarks on the calculation of alternating current effects, paid the following tribute:

"Any paper presented to the convention on this subject which does not mention Mr. Kennelly's name would be defective. Of all the beautiful expositions of profound mathematical work in the simplest language which can be understood by any student in our technical colleges, there is nothing in the literature of the day to come up to the writings of Mr. Kennelly for the last year or so." Mr. C. F. Scott, electrician of the Westinghouse company, said: "I heartily agree with Prof. Forbes in his remarks concerning Mr. Kennelly. The article[8] he brought out a month or two ago treating the problem of the alternating current circuit in its relation to self-induction, capacity and insulation resistance, is a very comprehensive and elegant solution of the general problem."

[4] The Electrical World, Oct. 27, 1893.
[5] The Electrical World, April 22, 1893.
[6] The Electrical World, Jan. 6, 1894.
[7] The Electrical World, Feb. 17, 1894.

Electricity on the Canals.

Superintendent of Canals Edward Hannan has granted a fifty-year permit to the Cataract General Electric Company authorizing it to enter upon all canal lands of the state for the purpose of constructing either on or over or under either canal bank a system for propelling canalboats by electricity, without interference with the present method of operation. Central power houses may be erected. The rates for towage shall be subject to modification and review by the State Superintendent of Public Works, but such rate shall not exceed $20 per electrical horse power for any season of navigation. An important provision is that the company may, so long as the wants of the canal are supplied, employ its electric plant along the line of the canal in furnishing electric light, heat, and power for distribution to any point or points beyond the line of the canal. The company is to furnish the state, free of charge, sufficient power to operate motors to open all gateways leading to and from locks, and also electric lights sufficient to properly illuminate such locks at night.

The company must have its plant for operating boats by electricity in operation on the Erie Canal between Buffalo and Albany within three years from date, or else the privilege accorded by the permit shall be forfeited.

The company will obtain its electrical power at Niagara Falls, from the Niagara Power Company, and transmit it to Albany along the line of the Erie Canal. There is another company, having the same directors as the Cataract company, called the Erie Electric Towing and Power Company, with principal office in New York City. This company will construct and put in operation as soon as possible, a half-dozen tugboats, operated by electricity, either on the storage or trolley system, with a view of showing the adaptability of electricity to canal navigation. These tugboats will also tow for a moderate consideration any horse boats, the captains of which desire to avail themselves of such method.

Mr. Hawley states that $20 is the maximum charge that can be made, but that the rate will undoubtedly be much lower. Even at $20 a horse-power, he says that an owner would be saved 50 per cent. a season on the operation of his boat, in comparison with the present cost of propulsion.

[8] The Electrical World, Jan. 6, 1894.

Polyphase Transmission.—II.*

BY CHAS. F. SCOTT.

POLYPHASE CIRCUITS.

THE subjects which have so far been considered apply to single phase as well as to polyphase circuits. The effects of self-induction will be brought to the attention of the electrical engineer much more prominently in connection with polyphase work, however, because larger alternating current enterprises will be carried out with the polyphase system, and power work involving variable power factors will be a large element in this system. There are, in addition, several problems which relate distinctively to polyphase working. One of these is the most suitable number of phases to be used. The two-phase system and the three-phase system are both in operation, and while it is admitted by the adherents of each system that there is no fundamental difference between them, yet each has specific characteristics giving particular advantages.

ADVANTAGES OF THREE PHASES.

It has been recently emphasized by a good many people that the single-phase system and the two-phase system require the same weight of copper, and that the three-phase, three-wire system requires 25 per cent. less for transmitting power under similar conditions with the same maximum E. M. F. This places an advantage on the side of the three-phase system, which in many cases is of very considerable importance. The aggregate advantage, however, is greater than 25 per cent. A two-phase system laid out for the greatest economy requires that the interest on the cost of conductors shall equal the cost of the power lost. If the three-phase system be substituted, the loss may remain the same, and the copper will cost 25 per cent. less. This does not give the best relation between cost of copper and loss of power, so that a more economic adjustment is possible.

It has also been shown that the self-induction of a three-phase, three-wire circuit for transmitting under similar conditions of E. M. F. is only 57 per cent. of that which is incident to the two-phase, four-wire circuit. When the power factor is high, the effect of self-induction of line upon regulation varies approximately as the square of the counter E. M. F. The drop due to the self-induction of a three-phase circuit is therefore only about one-third of a two-phase circuit. This is a second advantage for the three-phase system which is of great value. A further advantage of three instead of four wires is the reduced cost of insulators and pole construction, the reduced losses due to leakage, etc.

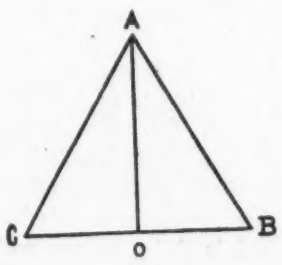


FIG. 14.

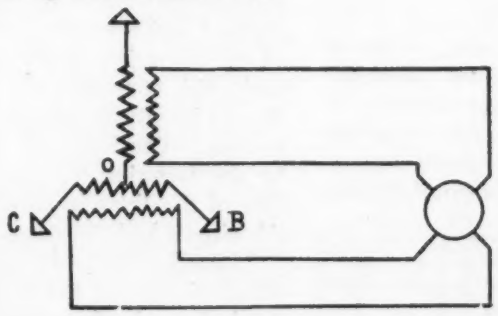


FIG. 15.

ADVANTAGES OF TWO PHASES.

An important point of difference between the two systems is the effect of loading one branch of the system more heavily than the others, as is common in incandescent lighting. One of the statements which remain uncontroverted in Prof. Forbes' recent comprehensive and remarkable paper upon the "Electrical Transmission of Power at Niagara Falls" is in reference to the difference of regulation in dynamos for two-phase and for three-phase alternating currents. He gives the result of tests showing that the circuits of a three-phase generator differ greatly in pressure if they are not equally loaded, and states that having considered these points the directors of the company determined to reject the three-phase system. These results agree fairly well with tests which I have made. The relative regulation of the two types of machine depends very largely, of course, upon the character of the construction. Although it is not just to condemn one system because a certain construction is bad, yet the theoretical and practical tendencies toward the evil are largely removed by discarding the three-phase type.

If independent regulation of circuits is necessary, one circuit can be given the proper pressure directly from the dynamo and the other circuits may be raised or lowered, as may be required. This involves apparatus for regulating two circuits if the station be operated by the three-phase system, and only one circuit if the two-phase system is in use.

In a system where incandescent lighting is to be a prominent feature, or where load of any kind may be required upon one circuit and not on the other, the two-phase system has, therefore, a decided advantage in station regulation over the three-phase system. Another advantage of a two-phase circuit is that the load is separated into two divisions instead of three divisions, which is in general much simpler. A further advantage of the two-phase is in the reduction of potential for motors. Two transformers are sufficient in the two-phase system, whereas three transformers are commonly used in the three-phase system. The two transformers which would be required for small motors will cost considerably less than the three transformers which would be required on the three-phase system, and the loss in transformation will be much less, as there is not much difference in the cost of small transformers of slightly different sizes, and the large sizes are more efficient. The ease and simplicity of installation is also a gain for the two-phase arrangement.

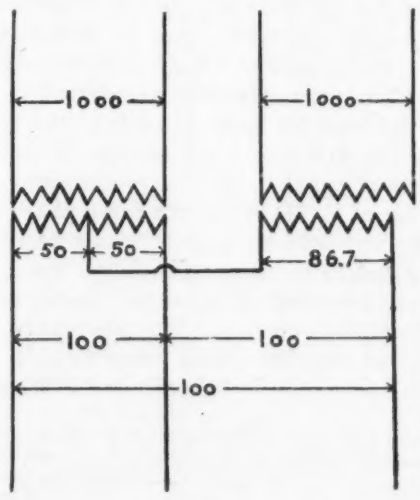


FIG. 16.

A NEW SYSTEM.

In considering the marked advantages of the two-phase system for distribution and of the three-phase system for transmission, it occurred to me that a combination of the two systems might secure the advantages of both in a combined system, and I have worked out a simple and effective

*A paper read before the National Electric Light Association, Washington, D. C.

method of accomplishing this result. It is well known that if two E. M. Fs. differing in phase be connected in series that the resulting E. M. F. will, in general, differ in value and in phase from either of its components. If two E. M. Fs. differing in phase 90 degrees be connected in series, the resultant E. M. F. is represented in direction and magnitude by the hypotenuse of a right angle triangle, of which the

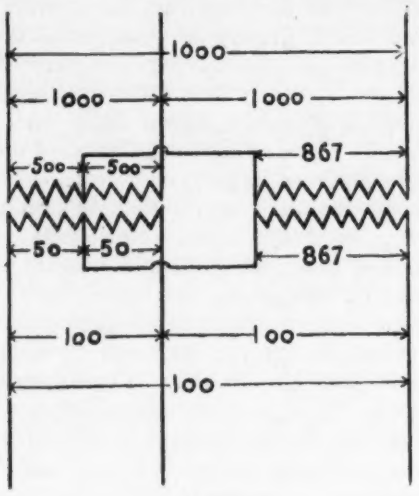


FIG 17.

two sides are the two component E. M. Fs. Thus, in Fig. 14, if *A O* and *O B* are two E. M. Fs. at right angles, and these E. M. Fs. be connected in series, the resultant is the line *A B*, of different phase from either of the components. It is a simple matter to so proportion the components that *O B* is equal to one-half of *A B*, as shown in the diagram. In a similar manner it is readily seen that the same E. M. F. *O A* may be combined with *O C*, which differ from it by 90° (but is equal and opposite to *O B*) in such a way as to give *A C* equal to *A B*, but differing in direcs tion. *B O* and *O C* added together give *B C*. The E. M. F. *B C* may therefore be combined with the E. M. F. *A O* at right angles to it in such a way as to give additional E. M. Fs. *A B* and *C A*, which, in connection with *B C*, give three equal E. M. Fs. 120 degrees apart. This is the relation of E. M. Fs. in the three-phase system.

The application of this arrangement to transformers is illustrated in the accompanying Figs. 15 and 16. The primaries of two transformers are connected to a generator giving two-phase current. The secondary E. M. Fs., therefore, differ 90 degrees. One secondary is made equal to 100 turns and a loop is brought out at its middle point, giving

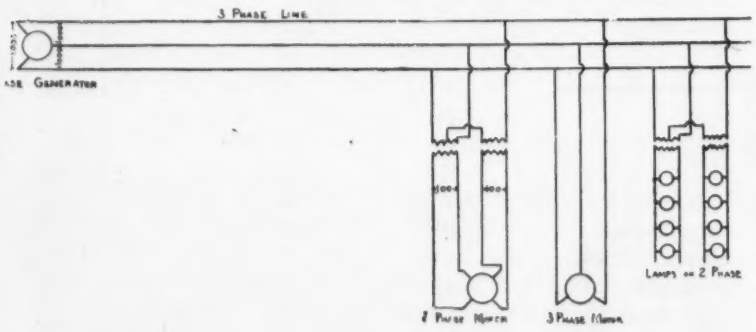


FIG. 19.

50 turns at each side. The second secondary has 87 turns, which is approximately equal to 50 multiplied by the square root of 3. One end of the secondary circuit is connected with the middle point of the secondary of the first transformer, as shown, and the three free terminals will then deliver E. M. Fs. differing in phase 120 degrees. If the E. M. F. on each primary be 1,000 volts and on one secondary 100 volts and on the other 87 volts, then the E. M. F. measured between any two secondary terminals will be 100 volts. This three-phase circuit is adapted for operating three-phase motors. In a system of transmission two-phase currents at the generator may be converted into three-phase currents, as shown in Fig. 18, and the windings may be such that the E. M. F. is raised for transmission. The currents are then transmitted by three phases, effecting economy in copper. At the other end of the line a similar arrangement of transformers may be used for converting from the three-phase to the two-phase system. The two-phase currents may then be used for the operation of two-phase motors or the circuits

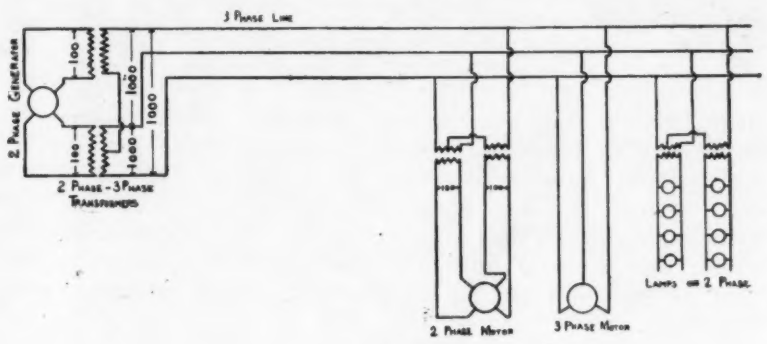


FIG. 18.

may be independently loaded with lamps, or otherwise. If lamps be placed on the transformer which supplies directly from its two terminals, the transmission is directly from the generator without affecting in any way the other circuit, as the generator terminals are connected directly to the first primaries, and the secondaries of the raising transformer are connected directly to the primaries of the lowering transformer, and the current from this is taken directly to the load. On the other hand, if the other circuit be loaded, the action here will also be on its own generator circuit without affecting the first. The current from the raising transformer in this circuit passes to the middle of the secondary of the other transformer, where it divides and flows in parallel through the two parts of the coil and two of the lines. As one-half of the current flows through each part of the secondary coil in opposite directions, the self-induction is completely neutralized and the transformers in this circuit are independent of the operation of the other circuit. It is to be noted that under this condition the line E. M. F. delivered by this transformer is only 87 per cent. of that delivered by the first transformer. The lower E. M. F., however, is compensated for by the fact that the current on one side is passed through two of the lines in parallel, thus reducing the resistance of the circuit and compensating for the slightly lower E. M. F.

The effect upon the regulation of the generator when two-phase circuits at the end of a three-phase transmission line are independently loaded is found, both by theory and test, to be the same that prevails when the load is placed directly upon the corresponding circuit of the generator. A modification of this system is found in the arrangement where the three-phase current is produced in the generator and transmitted over three wires to the reducing transformers. These transformers may be arranged as described for producing two phases. (Fig. 19.) Loads may be placed upon either of the two-phase circuits, and practically the same regulation in the generator will result that would have resulted if the generator itself had been wound for two phases and one of these circuits loaded. In this way it is possible to place lighting load upon a three-phase generator in two instead of three units, and to avoid the bad regulation in the generator due to unequal loading.

A similar arrangement of two transformers may be used for converting three phases of one potential into three phases

of another potential. This arrangement is shown in the accompanying Fig. 17.

The efficiency of two transformers arranged for converting from two-phase to three-phase is reduced below that when working independently on ordinary loads by an insignificant amount. If the efficiency in ordinary working is, say, 97.5 per cent., it would be reduced to 97.4 per cent. in converting from one number of phases to the other.

The Tesla polyphase system, in which the largest electrical enterprises are seeking a realization, adapts itself with marvelous facility not only to all branches of electrical industry, but also by the transformation of its phases to the utilization of three phases for gaining the highest economy in transmission, and of two phases for securing the maximum advantages in distribution.

DISCUSSION.

Prof. Forbes.—It gives me great pleasure to speak on the exceedingly interesting paper which has been read to us by Mr. Scott. The paper has really several totally distinct points of interest. Let us begin with the last part first; that is to say, I would like to say a few words simply to express the admiration I am sure every one has felt for the great ingenuity which Mr. Scott has displayed in working out this beautiful arrangement of a combination of the two-phase and three-phase systems together. We must all admit that it is an extremely beautiful idea and appears on the face of it to be a feasible method. With regard to the practicability of it, I think Mr. Scott will agree with me that it must be left to the test of experience before we can say whether it is a satisfactory method of working, as satisfactory as the two-phase or three-phase systems separately. On the face of it it looks as if it were so.

I confess I do not appreciate so much as he seems to do the superior advantages of the three-phase system for transmission over long distances. It seems to me that the two systems, so far as we can find out in practice, as to their economy, etc., have little advantage one over the other. That is the conclusion I have come to, but Mr. Scott and others hold different opinions. If the opinion be right that the three-phase system has a distinct advantage over the two-phase, then such a scheme as Mr. Scott's ought to prove of great value.

I am sure that if there are any members of the convention present who are devoted to the direct current system and determined never to hold any other opinion whatever may happen, they will be extremely pleased to learn all the apparently intricate calculation and investigations that have to be made by the ordinary electrical engineer in dealing with the alternating current; but as a matter of fact many of these problems and apparent difficulties of calculation to which Mr. Scott has alluded do not become very important in the ordinary electric lighting or power station work with alternating currents of moderate dimensions. But these matters of the self-induction of the line, and the influence of different circuits upon each other, become of the very utmost importance when we are dealing with the transmission of power over great distances and on a large scale, and carrying a large amount of current through our mains. I need hardly say that in the course of the last year or two in connection with the transmission of power at Niagara it has been my duty to go into these points that Mr. Scott has touched upon very fully indeed; and in a large problem like that the importance of these incidental matters to the alternating current, the dropping volts, the self-induction of the loop circuit of the line, etc., are so important that one cannot spend too much time in investigating them prior to the establishing of the plant. I have in the course of this work prepared for my own use a variety of tables and curves illustrating the effects and enabling one to get the results in a particular case at a moment's glance, and it has been my purpose to publish these tables and curves for the use of others; but Mr. Scott has gone a long way to make this unnecessary.

I would particularly thank Mr. Scott for this diagram which shows the inductive electromotive force in volts per ampere per thousand alternations per thousand feet of circuit at different distances between the centres. The compactness of that diagram is extremely beautiful, and I am sure that it will be of greatest value to engineers who are planning large power distribution plants in the future.

Mr. Scott has mentioned the name of Mr. Kennelly as having worked in this line. Any paper presented to the convention on the subject which did not mention Mr. Kennelly's name would be defective. Of all the beautiful expositions of profound mathematical work in the simplest language which can be understood by any student in our technical colleges there is nothing in the literature of the day to come up to the writings of Mr. Kennelly for the last year or so. I think if we take this paper of Mr. Scott's in conjunction with those which have been written by Mr. Kennelly on the same subject, any engineer has got before him all that is required for calculating the effects of self-induction and capacity upon the circuit; that is to say upon the efficiency of the circuit and upon the dropping volts on the circuit. A little more has to be done, however, and that is the effect of resonance. The question of self-induction in the circuit is too full. We first have to deal, as Mr. Scott pointed out, with the whole circuit as forming one loop within which lines of force are formed, which cut both conductors, and therefore produce E. M. F., and then you have to consider the back E. M. F. which is induced in the conductors themselves. Now, if we have a conductor, an inch in diameter we will say, if that were built up of a number of wires a current suddenly started in these would induce a back E. M. F. in each of the others, and, therefore, every one of these wires would be acted on by the others, but it is obvious that the central wire of the bundle would be acted upon more by the others than any other; and, therefore, the back E. M. F. would be the greatest in the centre of the bundle. Instead of a bundle of wires we have a solid conductor, but the effects remain the same and the back E. M. F. in the centre of the conductor prevents the current from passing through the conductor, and as it has to pass over the outside of the conductor there is a resistance to the passage of the current, and that is the skin resistance. These two elements have to be taken care of, and also the question of capacity. Capacity may tend to diminish the drop in the line. Now in regard to the lines of force that are formed in the loop of the circuit, as a matter of fact, even though E. M. F. produced by this line of force, being enclosed in the circuit, even though that E. M. F. may be considerable, it does not necessarily imply that the whole of that E. M. F. is taken off from the applied E. M. F. That is to say, suppose we found in a long circuit going from Niagara to Buffalo that there were 1,000 volts in the circuit due to this self-induction, that does not necessarily imply that there is a drop of 1,000 volts, because from the sketches which Mr. Scott showed you, the E. M. F. is not in phase with the current. In fact, the chances are that it is nearly 90 degrees away, and therefore the actual drop is much less than that. But here is a case which we have to consider and which is of the utmost importance. Mr. Scott has spoken of the interference of separate circuits upon each other. If he had considered the question of these circiuts—two different circuits, being the circuits of a two-phase circuit of a distribution, one being a quarter of a period behind the other—then we have a very serious interference. Suppose this current is changed from positive to negative. At the moment when it is zero there is a maximum electromotive force cutting the field and that maximum electromotive force cuts the other conductors which carry the current a quarter of a phase be-

hind, at the very moment when that current is at its maximum. Therefore, the E. M. F. induced by one circuit upon the other is in phase with one current in the other conductor, and the pole of the electromotive force thus generated is a drop in the E. M. F. of the other circuit. For this reason you will see that it is of the utmost importance in a large station where the polyphase system is employed to consider most carefully the arrangement of the conductors in your subways or on your poles; so that the interference of one circuit upon the other shall be a minimum. This interference between the two circuits is of very great importance, far more important than the self-induction of one of the circuits upon itself; and it is largely owing to the trouble that may arise from this and largely owing to the trouble which may arise from capacity that I have to look more carefully into the subject and have found the lower the frequency the less do these things trouble us. It is largely, I say, owing to these reasons that we determined at Niagara to reduce in our dynamos the frequency to as low a point as was consistent with the construction of good, sound generators; and that is largely the reason why we have reduced our frequency to so low as twenty-five periods a second.

I take this opportunity to say a few words not directly on the subject in hand. Many persons have been surprised that the Cataract Construction Company and myself have taken no notice of numerous fault findings and misstatements that have at different times appeared with regard to our work at Niagara. We have not the slightest intention of paying any attention to these whatever. All that we want to do is to have our work done properly, and it is of no moment to us what opinions others may hold. We have not adopted any particular system; we believe that by the construction of dynamos of two phases we shall be able to meet all the requirements that will come to us. We are, however, ready to utilize every invention of merit. We have ordered the construction of a certain number of dynamos by the Westinghouse company; they are devoting their energies unsparingly to producing splendid machines and we are confident of the final result. I think it advisable to make these remarks, because it is not often that one happens to meet one's friends in this way; and I am glad to explain why we do not consider it necessary to take any notice of such criticisms as have occurred.

Prof. Rowland.—It is with great pleasure that I rise to say a few words with regard to this invention of Mr. Scott's. As far as I can see, it is one of the finest things that have come out in recent years in this country. Very few of us expected that we would be so soon able to transform a two-phase system into a three-phase, or any number of phases. It gives us possibilities in the working of motors, etc., which we had not before, and I think this paper marks an era in the science of the polyphase system. It is curious that I happened to be writing a paper at the present time upon something on this very subject—the subject of transforming one number of phases into another number; that is, two-phase into three-phase, etc. I think I have also solved the problem of transforming any polyphase system into any other polyphase; also with any different period of the current. That is a little broader than this is; at the same time, my method is not in any way so practical as this, and is not so simple, and in no way bears comparison with it. It has, however, a little broader aspect, as I can change the period of the current at the same time that the number of phases is changed. It is not, however, practical, like this beautiful method of Mr. Scott.

In regard to the period of the current, this is an important question in long distance transmission, in the use of motors of the Tesla type, or the alternating current motors of all sorts. Although I quite agree with Prof. Forbes that a low period is very excellent in many respects, I was not able to agree with him as to the exact figures—when you get down very low, things happen that would not happen with a reasonable frequency. I have been studying the subject especially of the Tesla motor, and I see no reason in that motor for lowering the frequency; as good motors can be made for a reasonably high frequency as for a low one. When it comes to the subject of transformers, of course, the larger the period the better the transformers become, and the smaller the period of oscillations of the current, the larger the transformers, etc.; so that there is some limit to this question of frequency. I have only to say once more that this invention of Mr. Scott seems to me to mark an era in the science of this current.

Mr. Scott.—I was a little afraid, in presenting some of the subject taken up in the paper, that there would be somewhat of a scare with regard to the use of alternating currents, and that it would be apprehended that they would give rise to some trouble; but usually if a subject of this kind is taken up in the right way, the difficulties may be overcome by the right kind of engineering, and the observance of a few of the precautions mentioned, the running of two wires in the circuit close together, and some other practical points of that kind, which will readily suggest themselves—may be handled seuccessfully; if one studies the diagrams and makes use of them, and takes his own problems and works out the exact electromotive force and the exact effects of the conditions he has, they will give him an accurate notion of the extent of these effects.

I heartily agree with Mr. Forbes in his remarks concerning Mr. Kennelly. The article which he brought out a month or two ago treating the problem of the alternating current circuit in its relation both to self-induction and capacity and insulation resistance is a very comprehensive and elegant solution of the general problem. In ordinary working, however, capacity will have very little effect upon the practical conditions with which the ordinary central station man will come in contact. It is only when we get up to very high voltages or very long lines that the effect of capacity will enter in a marked degree into the operation of the circuits. The so-called skin resistance, or increase of resistance of the conductor, due to the uniform distribution of electric currents referred to by Prof. Forbes, in ordinary working may be very largely neglected. This effect decreases as the number of alternations increases, so that with sixteen thousand alternations the increase in resistance in a conductor half an inch in diameter is only three per cent., or thereabouts, so that ordinarily this is an insignificant amount. In order that the resistance shall not exceed this, with low alternations, three or four thousand, the diameter of the wire must be something like an inch or an inch and a half.

Prof. Forbes pointed out that the action of one circuit on the other is such that the electromotive force induced is in phase with the electromotive force on the first circuit, and the latter causes a greater drop than would be caused if the two circuits were at the same phase. This is true, and the reflex action is an interesting one; the action of one circuit on the other is to decrease the electromotive force, and the reverse action of the second circuit on the first is to increase its electromotive force, so that circuits become unbalanced—the electromotive force of one circuit increasing and that of the other decreasing.

In reply to an inquiry from Mr. Spenser in regard to the application of the load factor when the load is distributed along the line, Mr. Scott stated that when the load on the circuit is distributed the case becomes more complicated. It would be necessary then to take each part of the circuit and calculate the amount of electromotive force in it, and so on for each part of the circuit, and the problem in general would be very similar to the calculation of the drop in different parts of a continuous current circuit, which is much broken up, and the load distributed and the wires interconnected. It becomes quite a difficult problem to apply the

simple Ohm's law in a case of that kind. In practice, however, the counter electromotive force in primary circuits of one or two thousand volts extends over a small area—a mile or so—and with ordinary currents up to one hundred amperes is not such as to cause effects of very great practical importance. That is shown from the fact that in the circuits ordinarily operated these effects have not been very prominent. They have not interfered with the working of central stations of pretty large capacity. For instance, at the World's Fair, the circuits there were the largest incandescent lighting plant which has been installed, and one of the lessons of the World's Fair is that a large alternating incandescent central station can be operated, and that these effects of self-induction and capacity, which under certain conditions may give rise to difficulties, in the operation of this large central station gave no disadvantageous effects. In general, the inductive drop in circuits for incandescent lighting is only a small percentage of the ohmic drop, and it is an extreme case when the drop due to induction equals the drop due to the resistance of the conductor.

Mr. Stillwell.—I have been pleased to note the interest which those members of the Association who are managers of central stations have taken in Mr. Scott's paper. One of the things which manufacturing companies have to contend with and one of the obstacles which is in the way of a more rapid development of new apparatus—the turning out of practical alternating current motors—is the fact that the time of a considerable part of the electrical staff of the large electrical companies is taken up in answering questions—largely in the line of the points covered by Mr. Scott's paper. The operators of central stations employing alternating currents have run across these phenomena from time to time, they have not understood them—none of us have understood them thoroughly until recently—and they naturally call upon the engineers of the manufacturing companies to help explain them. Every member of the Association should make it his business to study this paper, and there is nothing in it which any central station manager need fail to understand. I think it is not out of place to congratulate the Association upon the fact that at this meeting—and I think for the first time—an invention of great scientific interest, as well as great practical importance, has been first laid before this body. A year or two ago it would, undoubtedly, have first been presented to the American Institute of Electrical Engineers. I think it is a compliment to the Association, and an evidence of the fact that the efforts of the Association to study these problems are understood and appreciated.

The paper is specially important in view of the fact that we are just now approaching the time in this country when there will be a necessity to supply arc service and motor service from our incandescent circuits. Many of you have already felt the pressure which is being exerted to drive you underground with your circuits. When that time comes the importance of being able to supply all kinds of service from one system of conductors will be great.

In regard to criticism made by Prof. Forbes: There has been some controversy over certain points, which are familiar to the electrical fraternity. We claim that the plans at Niagara Falls are substantially those laid out by Mr. Tesla several years ago. The statement we issued, as nearly as I can recall, was this: The plans which have been adopted by the Cataract Construction Company for their work at Niagara Falls are simply the Tesla polyphase system, as developed by the technical staff of the Westinghouse Electric and Manufacturing Company. Prof. Forbes says that statement is not correct. From a lawyer's standpoint it is incorrect in this respect, my attention having since been called to it. The Niagara Falls company have ordered three two-phase generators; they have not ordered any motors. These latter will be one or two phase. If they are two-phase, the statement stands without amendment; if they are one-phase it also stands without amendment—because the language is this—the Tesla polyphase system as developed by the Westinghouse company. We made no small exhibit at the World's Fair, in the power transmission department. We had a 500-h. p. generator, driving a 500-h. p. motor, and a smaller one. It was the alternating current system. It was of the constant potential type, and the motors there shown were of the two-phase variety. The frequency was thirty periods per second, or thirty-six hundred alternations per minute. The potential was four or five hundred volts. We showed motors of the non-synchronous and synchronous type. We did not show single-phase motors in operation, but they could have been run by these generators. In the case of Niagara Falls, we have the frequency reduced to twenty-five periods; but this difference is hardly sufficient to differentiate between the two systems. I do not suppose that in the strict sense any difference in frequency could be taken as a line of demarcation between the two systems. The potential at Chicago was 400 volts and at Niagara it will be 2,000 volts, for certain reasons. The difference of potential does not differentiate between two systems; it is selected with reference to the distance over which we are to transmit the power. Electrically speaking, these are the only differences between the plant at Chicago and the one at Niagara.

Prof. Rowland.—As I know all about this Niagara Falls affair, and know exactly what was recommended and what was not recommended, I may say that Mr. Stillwell's statement is correct. The things advocated are not the things which are now there.

A Switch Patent Suit.

Judge Coxe last week rendered a decision in the case of the Schuyler Electric Company against the Electrical Engineering and Supply Company, of Syracuse, N. Y., for infringement of the Perkins snap switch, the decision being in favor of the latter.

In his opinion Judge Coxe says, after examining into the prior state of the art, that it is perfectly clear that the Perkins patent does not cover all snap action circuit breakers and that it is confined both by the prior art and its own language to the device described. At least it is clear that it cannot be expanded to cover devices differing in size, shape, material, situation, mode of operation and object to be attained; devices whose only points of resemblance are features open alike to defendant and complainant.

The Crowell switches, he says, are snap switches, it is true, and they cannot be turned backwards, but in other respects they are much nearer several structures found in the prior art than to the Perkins switch. They are mounted on a large stationary china base, 3 inches in diameter and are intended to be screwed on a wall or other support. They cannot be used in a lamp socket, neither has a rachet wheel, and No. 2 has no insulating teeth or any equivalent therefor. Neither has a pawl or detent, unless a very broad construction is given to these words. Both belong to a different type of switch from the patented switch.

The court cannot avoid the conclusion that it would be doing injustice to the defendant and others to give the Perkins patent a construction so broad as to suppress improvements like those embodied in the Crowell switches.

Mr. Kapp Explains

In a recent issue we published some information which was sent to us regarding Mr. Gisbert Kapp, who was reported to have accepted an appointment in Germany. In a letter published in the London "Electrician" Mr. Kapp states that his leaving England is in contemplation, but by no means certain; he has been offered the appointment, but the matter is still pending and will not be settled for about a month.

Private Electric Light Plants.

BY FRANK C. PERKINS.

DURING the past year a great many plants have been installed for lighting city and country residences throughout the United States. Many of these lighting installations have no storage battery plants connected with them, although for residence lighting it is a great advantage to be able to shut down the engine at night and yet have current at your disposal at any time.

It is becoming common to install small plants, ranging from 25 to 100 lights, in stores and residences, and it may be interesting to note some of the methods of English practice in these lines. The English firms, Patterson & Cooper, Drake & Gorham, and others, have installed many small plants complete in such country mansions as Balnagown Castle, Ross-shire, residence of Sir Charles Ross; Craig-ynos Castle, near Swansea, residence of Madame Patti.

Undoubtedly the gas engine has received greater attention in England with reference to its adaptability for driving electric light machines than it has in this country. Figs. 1 and 4 show the plan and elevation of a gas engine plant installed by one of the above firms for running 50 lights of 16 c. p. each. The engine room is 18 feet long by 9 feet wide, and the storage battery room is 9 feet long by 6 feet wide. The

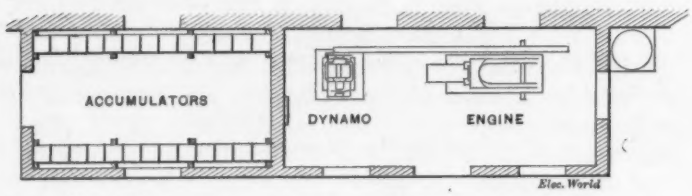


FIG. 1.—PLAN OF GAS ENGINE PLANT.

engine develops 4 h. p. and drives a 5-unit dynamo. The dynamo is wound for a potential of 135 volts, and is used to charge a storage battery of 53 cells. Fig. 2 shows the arrangement of a steam plant commonly used by the same firm in private isolated plants; the engine room in this case being 24 feet long and 8 feet wide, and the storage battery room 9 feet long and 6 feet wide.

A semi-portable steam engine and boiler of 3-h. p. capacity is belted to a shunt dynamo, which is wound for 135 volts and is capable of supplying current for 50 lamps of 16 c. p. each. The engine is mounted on a cast iron ash pan, with feed water cistern under the smoke box, and is fitted with an efficient water pump.

The accumulator installation consists of a storage battery capable of operating 25 16-c. p. lamps for a period of nine hours. The D. P. storage cells are used. It is claimed that these batteries combine the durability of the Plante cell with the capacity of the pasted form. The special construction of the plates affords an enormous working area, enabling the cells to be charged and discharged at very high rates without producing disintegration or buckling. The battery consists of 53 cells, having a capacity of 140 ampere hours, the normal rate of charge and discharge being 12 amperes. The cells complete weigh about 65 pounds, including the acid. The outside dimensions of the cells are 12 inches long, 6 inches wide and 13 1-2 inches high. When fully charged the battery will operate 40 16-c. p. lamps of 60 watts each for four hours.

The "Neville" automatic accumulator switch is used in charging in order to prevent the current from the battery of accumulators discharging itself through the dynamo, when for any reason, such as a belt breaking or the gas supply of the gas engine being accidentally cut off, the E. M. F. of the dynamo falls below that of the battery. The objection to this class of apparatus usually is that it is actuated by springs or is so wound that during the whole time of working a small current is flowing from the battery through the instrument, causing waste and heating; further, that it has generally been found necessary to adjust them for one E. M. F., which has, therefore, been the highest one at which the battery was likely to be. Hence, when they are first started with the battery low they do not close the

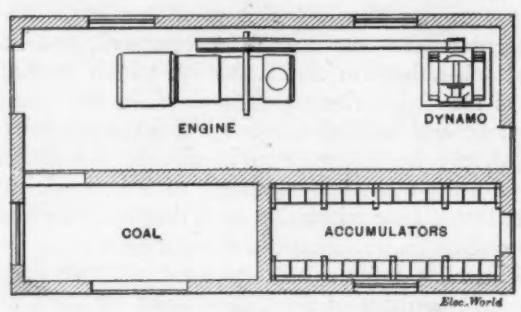


FIG. 2.—STEAM ISOLATED PLANT.

circuit until the dynamo is considerably above the battery in E. M. F., causing a jump in the lights, a shock to the dynamo and sometimes melting the main fuses by the large current generated.

This switch is constructed somewhat on the principle of a polarized relay, and is so wound that as long as the E. M. F. of the battery is greater than that of the dynamo, the circuit is held open, but as soon as the E. M. F. of the dynamo exceeds that of the battery, the tendency of the switch is to move. A difference of one or two per cent. is sufficient to close the circuit, and this is accomplished by a copper fork dipping into two mercury cups. The opening or closing of the circuit is effected when the E. M. F. on the two sides is practically the same, and therefore the current then passing is so small that even with a switch constructed to carry 200 amperes the spark is scarcely perceptible. If the battery is nearly run out, say at 98 volts, or if the battery is fully charged, say at 110 volts, the switch will, without adjustment, open and close within one or two per cent. of the E. M. F. which the battery is then giving. After the circuit has been closed the only loss of power in the instrument is that caused by the resistance of the large wire through which the current flows, and this is not worth considering.

The arrangement of switchboard is very convenient, and includes regulator switches for both charging and dis-

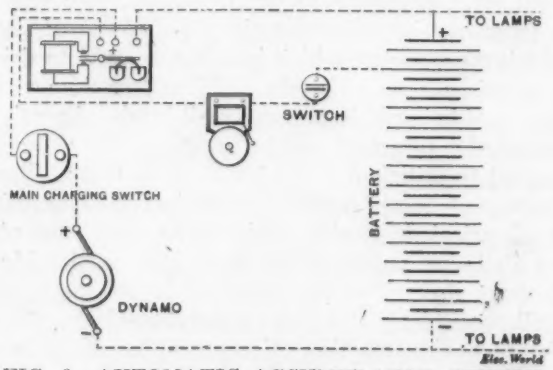


FIG. 3.—AUTOMATIC ACCUMULATOR SWITCH.

charging the accumulators, also switches for lamps and dynamo circuits, provision having been made for mounting voltmeter and ammeter for measuring either the charging or discharging currents.

The automatic accumulator switch may be connected in either branch of the dynamo circuit (Fig. 3) so that the cur-

rent (assuming that an electric current always flows from a positive toward a negative pole) shall flow in the pole marked + and out the other, noting that it is approximately level Each cup is filled with mercury up to the level of the small knife edges projecting into the cup. The balance weight is so adjusted that when not under the influence of any current the fork, when pressed down and gently released, will at once rise clear out of the mercury to its normal position.

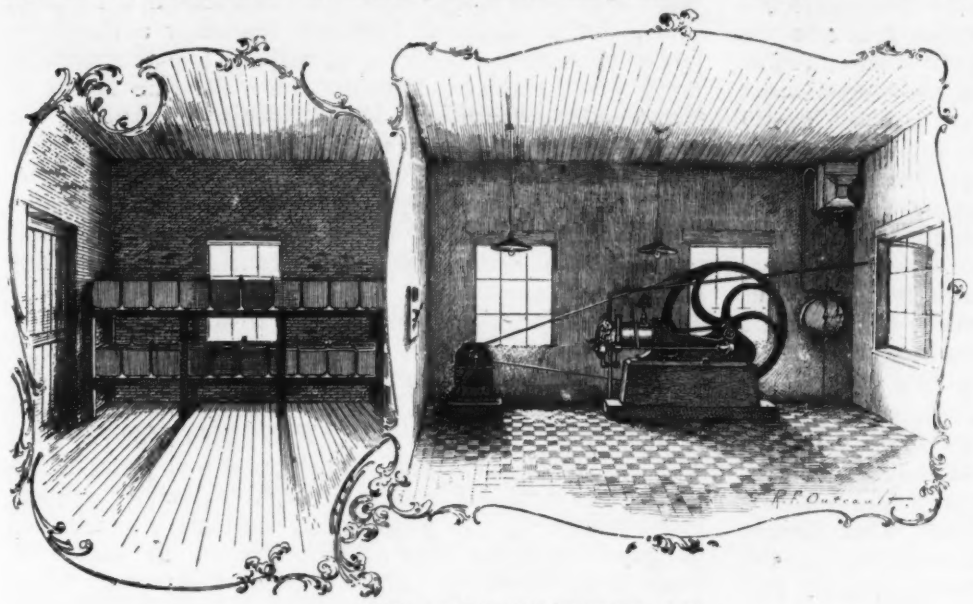


FIG. 4.—GAS ENGINE PLANT.

The main switch on the dynamo circuit may then be closed and the dynamo started. If properly connected when the voltage of the dynamo is about two or three volts higher than that of the battery, the automatic switch will work, and when it is once started there is no need of further attention. In some cases it is desirable to call attention, by means of a bell, to the fact that the switch has opened and that the dynamo is no longer charging the cells. In such cases an electric bell can be inserted in the circuit (Fig. 3) of the instrument in such a way that, as soon as the switch has opened and the E. M. F. of the dynamo has fallen much below that of the battery, the bell will ring, and thus call the attention of the man in charge.

The condition of each cell forming a battery may be ascertained during the discharge of the battery by means of a voltmeter and a hydrometer. Much can be determined by a careful examination of the cells when fully charged, at which time all the cells should give off gases equally, but without the aid of such instruments as a voltmeter and a hydrometer a decrease in capacity cannot be detected. The voltmeter readings should be taken toward the end of the evening's work while the cells are still discharging on the lamps, when the lower capacity of any faulty cells may be apparent. The specific gravity readings are useful in that they show approximately at any time, the charge remaining in a cell; and the discharge E. M. F. test is necessary to indicate whether any cell drops in capacity before the remainder. A rod is supplied with each instrument for insuring proper contact on the battery and enabling one person to make the test.

While a storage battery plant is a very convenient accessory to a residence electric lighting plant, it is very costly and requires a great deal of attention and continued watchfulness on the part of the attendant in order that the best results may be obtained. The 3-h. p. engine and dynamo will charge the battery during the day, and at night the engine, dynamo and battery can all work together and give a total output of 50 16-c. p. lamps, the battery supplying 25 lamps for nine hours.

There seems to have been no attempt made abroad to construct the steam plant so that the fuel and water may be supplied to the engines automatically. Some of the more recent plants installed in this country are so arranged that kerosene oil or natural gas can be used for fuel, and the water is automatically kept at the proper height in the boiler by means of a float attached to the feed pipe. If the steam pressure arises above 80 or 90 pounds, the fuel supply is automatically cut off, and when the pressure falls below 80 pounds the fuel is again supplied. In this way a plant can now be installed which will require little or no attention beyond that of starting and stopping. The engine and dynamo can be started at 3 P. M., and operated until 10 or 11 P. M., practically without attention. The dynamos used have automatic oil ring bearings, and the main engine bearings are lubricated from the crank case.

Magnetised Side-Arms.

It is reported that bayonets belonging to marines on board Her Majesty's ships have in certain cases become highly magnetized through contact with, or close proximity to, dynamos, or from other causes, the result being that compasses have become affected by sentries passing near them when wearing these sidearms. In future sentries are not to wear sidearms when on duty in the dynamo flats, and this is expected to overcome the difficulty.

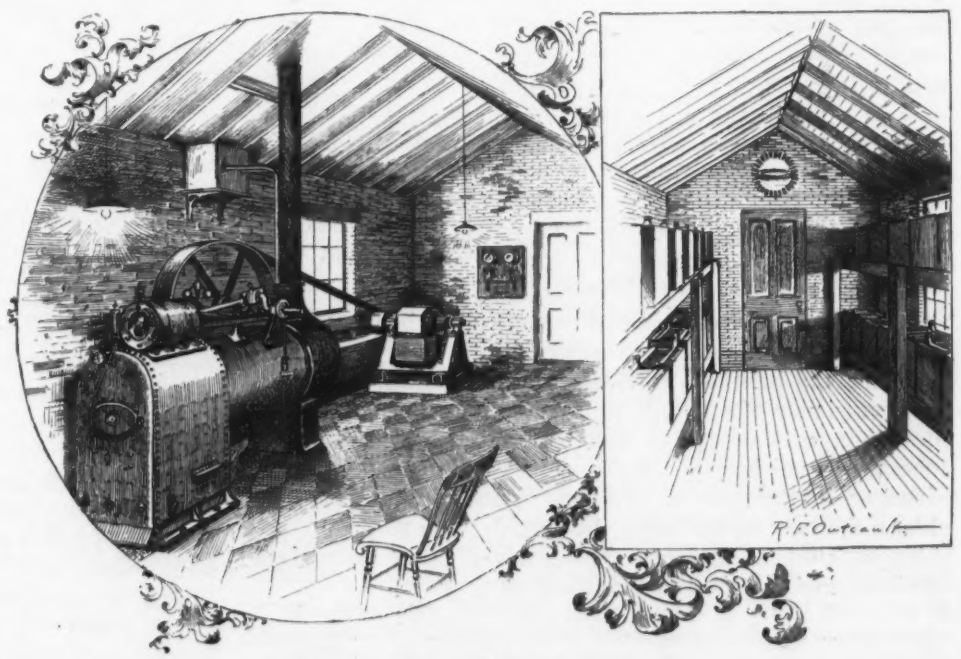


FIG. 5.—STEAM ISOLATED PLANT.

Practical Properties of Polyphase Apparatus.—III.*

BY LOUIS BELL.

THE place where it is most desirable to retain as high a value as possible for the power factor is where the motors are to be used on long circuits, in which case it is important to keep the general inductance of the system low. In this connection, however, nearly all the long distance propositions which I have investigated—and their number is very great—require the use of mixed apparatus—induction motors, synchronous motors and lighting, in which case the general energy factor can be kept fairly high, particularly as the synchronous motors can even be made to compensate in large measure for the presence of the induction motors.

A word now with reference to efficiency. Fig. 7 gives a pair of efficiency curves, one of them, *A*, taken from a 5-h. p. motor, the other, *B*, from a 20-h. p. machine. The 5-h. p. motor had four poles, the 20 h. p., six, and both were intended to run at 50 cycles. A glance at the curves will show that their full load efficiencies were respectively a trifle over 82 and 88 per cent., the larger motor in particular retaining a very uniform efficiency from half load up. These figures can be raised by paying the same attention to the iron as in the case of transformers which do not have a movable secondary.

The two in question had stampings of ordinarily good armature iron without extraordinary precautions in annealing. From a special 5-h. p. motor I have obtained a full load efficiency of very nearly 90 per cent. I can hardly refrain from comparing these efficiency tests with those of motors of similar size and of the synchronous alternating type, as made by Ganz & Co., and described in the report of

FIG. 7.

the Frankfort Commission, the periodicity being 42. In this case the maximum efficiency of a 25-h. p. motor was 88 per cent., the half load efficiency about 80, while the maximum efficiency of a 5-h. p. motor was but 80 per cent. All these are, of course, commercial efficiencies. Motors of other sizes will bear about the same relation to the figures given as in the case of ordinary continuous current machines, the two shown being thoroughly typical.

To conclude the matter of efficiency I annex the weight efficiencies of five sizes of induction motors:

H. P.	Weight per H. P.
5	103
10	66
15	68
20	73, 6 pole
100	66, 8 pole

These weights compare extremely well with those of any standard direct current machines, and were light weight a special object, could readily be considerably improved.

Much has been said regarding the effect of frequency on the properties of induction motors, and I am sorry to say most generally from a purely theoretical standpoint. Judging from numerous experiments between 30 and 70 cycles, I am strongly of the opinion that within this range not much is gained or lost by varying the frequency, provided the motors are designed with reference to the particular frequency at which they are to be used, although, as in static transformers, increased frequency tends to increased output. As reasons quite independent of the character of the motors which can be obtained limit the frequency advisable in power transmission work to something like the working range just mentioned, I do not think the gain is one of sufficient importance to cause a choice to be made of one moderate frequency rather than another. For example, low cycles compel the use of uncomfortably large 2-pole induction motors, while at high cycles even very small motors must have 6 or 8 poles. At 10 cycles the highest possible motor speed is 600, at 100 8 poles are necessary to get any decently low speed.

I will now briefly pay my respects to what are really unsymmetrical polyphase motors; that is, the so-called non-synchronous single phase motors, which start by means of some phase differentiating device, whereby a derived phase is employed to produce a sort of rotary pole. The result is what may be characterized as an elliptical rotary magnetization as distinguished from a circular one, and consequent loss of efficiency. In general they start and run like bad polyphase machines, have a less output for the same size, and a lower efficiency. These statements are amply borne out by figures which have been published on the Oerlikon three phase and single phase motors, showing that the latter have for the same output greater weight and less efficiency. The power factors of such motors are decidedly below those of polyphase motors. I believe that it would be possible, however, to design a motor of this class which should have nearly as good properties as the polyphase motors I have described, but it would be costly, and would perform much better if regularly wound for two or three phases. In other words, the same structure that would give a good single phase motor would give a phenomenal polyphase one. With single phase induction motors, the use of condensers would be decidedly advantageous, and they thus might be made fairly operative even at rather high cycles.

The static transformers used for polyphase work being, in all essential particulars, like those with which the public is already familiar, little need really be said on this score except that in most cases the average efficiency of transformers in polyphase plants will be found decidedly better than in the lighting plants now in operation, principally for the reason that larger units are, and will be, generally used.

The question of frequency is of more importance, however, and the general facts in the case are that the low frequency transformers, other things being equal, are the more bulky and expensive, though not in a very great degree. Within the working range for power transmission work the difference is, as in the case of motors, not so considerable as entirely to overshadow other considerations which arise in specific cases, such as those of permissible inductance, size of units, permissible heating, loss of energy generally under the particular circumstances considered, and the like.

The convenient and efficient use of rotary converters is a very characteristic advantage of polyphase systems. These machines have already been considerably discussed, and it is perhaps sufficient to say, as regards their general character, that they are, in all essential particulars, closely similar to standard direct current machines. They are self-starting, can readily be compounded for constant potential and behave in all respects like direct current generators. It is possible to make a single phase machine of somewhat smaller output for the same size, and non-self-starting. In actual operation they are highly satisfactory and appear to give

*Abstract of a paper read at the eighty-third meeting of the American Institute of Electrical Engineers, Jan. 17, 1894.

considerably better results than any methods which have yet been brought forward for converting alternating into direct current by any species of commutation.

As a good many of our friends who are not deeply versed in the electrical industry say, electricity is in its infancy, and from all I can learn, the art of directly commuting an alternating current and getting a decent direct current is very decidedly in its infancy.

In the use of rotary transformers, the frequency is a consideration of much more importance than in the case of transformers or of induction motors. It is a matter of some difficulty to build a large unit for high frequency, the difficulty being encountered, as might be expected, in the commutator. It is probably as easy or easier to build a 500-kw. unit for 30 cycles as it is to build a 100-kw. unit for 60, so that where, for any cause, it becomes necessary to use a large number of rotary transformers, this necessity may quite control one's choice of the precise frequency to be employed.

In all practical cases of transmission of power, rotary converters require the use of transformers for reducing the line potential, inasmuch as if they are not used the voltage on the main line will necessarily be so low that it would be quite as well or better to transmit the continuous current directly.

In planning a polyphase system one of the first questions that naturally arises is that of frequency in its relation to the machinery, the line and the service. So far as the first count is concerned, one can say that while in general the higher the frequency the less the bulk of the apparatus, each size of unit has a certain frequency which gives the greatest economy in material and labor. The larger the unit the less this frequency. The rate of change, however, is rather slow, and as an actual result of designing with economy in view, the largest units as yet proposed, 5,000 to 10,000 h. p., will show very little difference in economy between say 25 and 40 cycles. In discussing frequency, theorists have often fallen into the grievous error of considering only the generating units. The load of transformers and motors is of equal, in fact of greater importance, since the actual aggregate cost is far greater, and in nearly every practical case will call for a frequency considerably higher than in the case of the generating units. One might, for instance, by ignoring this fact, save $10,000 in the generators and lose $50,000 in the transformers and motors.

So far as the line alone is concerned, the lower frequencies are the better, since they reduce inductance and static effects. Nevertheless, too much importance should not be attached to this, since the vast majority of cases can be handled with perfect success at a frequency of 50 or 60 ∼. For example, one can transmit 1,000 kw. at 10,000 volts a distance of twenty miles or so on a single circuit (three phase) and still have the total impedance less than double the ohmic resistance. In practice, such a system would generally, too, carry a considerable output in synchronous motors, which can be, and should be, made to serve as gigantic capacities reducing, or even annuling, the inductive drop. Finally we come to the service. There is a frequency below which incandescent lamps cannot be operated without perceptible flickering. This frequency certainly varies with different observers and perhaps also with the same observer at different times. Prof. Mangarini and others have placed the limit as high as 40 or 50 ∼. The average eye, I think, is less sensitive than this. Personally, the limit seems to be about 30, ∼ certainly over 25 ∼ and under 35 ∼, and a number of other observers unite on about these same figures. It would be almost impossible not to notice variations at 25 ∼, and they are most annoying, not to say intolerable; 30 ∼ certainly leaves a small enough factor of safety.

Alternating arc lights are even more sensitive. The very best carbons begin to give considerable trouble at 40 ∼, and with most carbons flickering is perceptible at 50 or even at 60.

Inasmuch as most large systems find the arc lighting desirable, and practically all must use many incandescent lamps, the frequency should certainly be kept above 30 ∼ and preferably above 40. To go below 30 ∼ is wantonly to throw away the most characteristic advantages of the alternating system, and in the vast majority of cases is not worthy of serious consideration.

To my mind the most serious consideration in long overhead lines and all underground lines is static capacity. Particularly is this the case when the current waves are non-sinusoidal, for in such case we can get phenomena of resonance not only from the fundamental frequency, which is generally low enough to keep out of the way, but from the higher harmonics as well. These are liable to produce discharges that will rupture almost any finite insulation. For this reason the sine wave is highly desirable, far more than from any consideration of efficiency. I am sure, however, that a sufficiently close approximation to it can generally be obtained from a properly designed dynamo, and the inductance that generally exists helps to muffle the higher harmonics. Resonance is generally in evidence on long lines, however, and makes itself felt by a tendency to spark and sputter beyond the capabilities of the nominal voltage. It may prove advisable in some cases, when dealing with non-sinusoidal waves, to give the line artifically a capacity that will not readily respond to the most prominent harmonics. I remember once experimenting with a tuning fork with a sixth harmonic that quite drowned the fundamental, and it is quite possible to conceive of a dynamo with undesirable characteristics of a similar sort.

The upper limit of practicable voltage is most uncertain; 5,000 and 10,000 volts have been experimentally shown to be available, and 15 to 25,000 possible. If the conditions to be met render these voltages necessary, I think they can be handled well enough. The question really resolves itself into the commercial one of paying for the necessary precautions in insulation. A voltage will be reached, however, at which these precautions will cost more than the extra copper required for a lower voltage, and here commercial necessity will call a halt. This point, however, has yet to be experimentally found.

Whether these high voltages should be derived direct from the machine, or obtained from step-up transformers, is a question which has been often discussed. The high voltage dynamo in very large sizes has the advantage in first cost over a low voltage one plus transformers, but runs a far greater risk of serious injuries. Besides, what is of practical importance is that with a high voltage dynamo, if anything happens, the dynamo is gone. Take a 10,000-volt dynamo, let a rupture once get started, and it is a case of ruined machine practically every time. When you have transformers and a burn-out, you may have lost one or more transformers to be sure, but probably you are running banked. Indeed it is very foolish to put all one's eggs in one basket in such a matter. So instead of losing a 5,000 or 10,000-h. p. dynamo, you may lose only a transformer of 100 kw., or something of that kind. Although we would all like to use high voltage dynamos, on account of economy in first cost, until they have been practically proved to be sufficiently free from breakdowns, I should say it would be very poor practice to use them extensively, although they are now being tried somewhat, and I hope we shall find the result to be good.

I am now compelled to disturb a very much mooted question; that is, the amount of copper required for polyphase lines. It goes almost without saying that all polyphase systems using a complete circuit per phase will require the

same amount of copper as an ordinary alternating system. Some statements have been going around recently as to the relative amount of copper required for the alternating system and for the direct current, which, I think, are very largely founded on a misconception. They seem to proceed on the principle that in all cases where alternating currents can be employed we may consider direct current as a straightforward competitor. This is certainly not so. In a vast number of cases where we have to deal with voltages somewhere near the limit of insulation, the direct current is out of it from the start, and is not to be considered at all. In the second place, it is a grave question whether the electrolytic strains of the direct current are not under some circumstances, perhaps many circumstances, fully as bad as the electrostatic stresses caused by the somewhat higher alternating voltage. That is a subject that will have to be studied very thoroughly before we shall know quite where we stand. Now, as regards the copper required for polyphase circuits which are interlinked, I went to the trouble, for the sake of informing a few recalcitrant persons who do not want to believe a mathematical demonstration, of having an experiment actually made, setting up a triphase generator with a bank of lamps in the laboratory, and trying the relative conditions as between a single phase system and a triphase system with interconnected circuits. The experiment was performed in an exceedingly simple manner. Four non-inductive artificial lines were prepared, and using two of these in parallel, a certain amount of energy was transmitted to lamps banked at the other end. A single phase current was used and the losses carefully measured. Then one of the lines, this experiment having been made, was removed, and the remaining three wires worked on the triphase system transmitted the same energy at the same initial voltage, with the same loss, showing conclusively, as might be expected, that theory in the matter is quite correct and that the actual saving of copper in the interconnected triphase system is 25 per cent. The experiment came out within one per cent. of the calculated amount, and this must be true whatever assumption is made regarding the conditions under which we are to transmit power. Take a plain alternating system at any voltage you please, and compute the copper on any series of hypotheses that may suit your fancy, yet the interconnected three phase will do the same work and do it just as well with three-fourths the outlay for copper. It is precisely equivalent in its net result on the economy of the system to raising the voltage about 15 per cent., without, however, any added strain on the insulation, and I think the man would indeed stultify himself who would deny that raising the voltage affects the economy of the system. Aside from all other questions concerning it, an additional advantage of this particular type of circuit is the greatly reduced inductance for the same energy transmitted under similar conditions, amounting only to about 57 per cent. of that found on a single phase circuit. This reduced inductance, which, after all, is in part attributable to the less cross-section of copper required, or is rather interlinked with it, is perhaps the greatest advantage that this particular system has, and makes it of extreme value on all very long lines. There are not very many points which differentiate triphase from other polyphase systems, and so far as my knowledge goes, the two that I have mentioned are by far the most important, more especially that which relates to inductance and incidentally to capacity—getting around as it does the "bugs" which are most dreaded on very long distances.

Unfortunate.

Mr. Charles Henry, a French physicist of some standing, says that the intense electric illumination in our railway stations and large stores caused indigestion!

An Important Patent Suit.

The case of the Bate Refrigerating Company was argued before the United States Circuit Court of Appeals last week, C. E. Mitchell and J. C. Carter appearing for the appellant and W. H. Peckham and Edmund Wetmore for the appellees.

The point at issue is in regard to the meaning of the part of the paragraph of section 4,887 of the Revised Statutes, reading as follows: "But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent," the appellant contending that it should be construed to read "an invention which has been patented previous to the application for a patent therefor in the United States shall be limited," etc., while the appellees contend that the meaning is plain as it is.

The main argument of the appellant is that in the revision of the law on the subject the language had been so changed as to thwart the plain intent of the original framers of the law, and that the statute is therefore open to interpretation, and should be construed as above in harmony with the original law, and thus prevent great injustice to patentees. The appellees dispute the right to enter upon an inquiry as to the supposed intention of Congress, show that the courts have invariably maintained their view and argue that if the construction claimed is allowed it will result in gross injustice to the public.

The Electrolytic Production of Caustic Soda and Bleach.

The Electrolytic Caustic Soda and Chlorine Trust, of Snodland, Kent, England, is about to convert itself into a limited liability company, under the title of the Electro-Chemical Company, with a capital of £200,000 in 40,000 shares of £5 each, divided into 26,000 10 per cent. preference shares and 14,000 ordinary shares. Subscriptions are being now invited for the 26,000 preference shares. The syndicate is to be given the 14,000 ordinary shares, plus £30,000, either in hard cash or preference shares. This is no doubt a large sum to give for a process protected only by patent law, although it is not, as things go now, by any means extravagant, and the validity of the patents for the production of caustic soda and bleach by electrolysis has been thoroughly well ascertained. There is, of course, nothing particularly novel in the electrolysis of a saturated solution of common salt and the obtaining thence of caustic soda and chlorine, the latter being subsequently passed into chambers containing lime and converted into bleach powder. But the Snodland process has been experimented with on a commercial scale for some years, and it is not too much to say that the syndicate has succeeded in overcoming the most important difficulties which have hitherto barred the way to commercial success. The anodes first employed were made of comparatively costly electric light carbons, and were rapidly eaten away. At present, instead of trying to discover some unattackable form of anode, the syndicate is using the cheapest possible form of carbon, consisting of the ordinary gas retort carbon set in a frame of stout strip lead, so arranged that the lead is not in contact with the electrolyte. The cost of replacing these anodes only amounts to a few shillings per ton of caustic soda. Another specialty of the process is the absence of any form of porous partition and the employment of kathodes of copper, covered with a superficial film of copper oxide, which prevents the back electromotive force due to nascent hydrogen. Owing to these two improvements, the volts per electrolytic vat have been reduced from 6 to 4, the minimum theoretical voltage required being 2.02 volts. A consulting chemist of high standing gives as his opinion that caustic soda and bleach can be produced on a large scale by this electrolytic process at about half the present market price.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

NOTE.—*Owing to the crowded condition of this department the following changes will be made, the object being to enable more space and attention to be given to abstracts of articles and papers of a more important nature. Almost every issue of each of the foreign journals contains descriptions and data, often with illustrations and tables, of local central stations and isolated plants; unless they appear to be of special interest they will not be noticed hereafter. References to descriptions of steam and gas engines, boilers, fuels, etc., and all other subjects not belonging under the heading of electricity and magnetism, will in general be omitted. The Swiss monthly "Journal Telegraphique" (in the French language) contains probably the best telegraph and telephone statistics of the world, and as this Journal is doubtless accessible to those specially interested in this subject, references to such statistics and descriptions in that Journal will hereafter be omitted. Serials in the nature of a treatise on a subject will be noticed only once; this will apply also to papers which are continued in several issues and which are merely referred to in these columns as distinguished from being abstracted. When the same paper or article is reprinted or abstracted in several journals, only the first appearance will be noticed, except if the original is in a foreign language and the reprint is an English translation, in which case the references to the translation will also be given, as usual. Very good abstracts, generally longer than can be given here, are published in the monthly journal of the Institution of Electrical Engineers (London), and in the Proceedings of the Institution of Civil Engineers (London), which abstracts will be noticed only in case the original article has not been mentioned in these columns.—C. H.*

ELECTRO-PHYSICS.

Cosmical Electricity.—In a communication to the Lond. "Elec. Rev.," March 2, Prof. Elihu Thomson replies to a recent criticism of his remarks (see Digest Feb. 17), and states that the criticism was due in part to the want of the full text of his remarks, in which he was particular to point out the difference between science and speculation, and laid stress on the fact that his remarks come under the head of speculation, in which case the unfavorable criticism was not justified.

Apparatus for Studying Hertzian Oscillations.—In a paper from the Italian by Mr. Righi, abstracted briefly in the Lond. "Elec.," March 2, he describes a modification of the apparatus for lecture purposes, for which he claims decided advantages and with which extraordinarily short waves have been investigated, the shortest being 7 centimetres long.

Differential Equation of Electric Flow.—The Lond. "Elec. Rev.," March 2, discusses editorially Mr. Blakesley's Physical Society paper, in which he shows that the admission of certain properties of matter not usually recognized is the only way of obviating satisfactorily the imperfections of existing views.

Electro-Dynamic Screening and Electric Shadows.—The Lond. "Elec. Eng.," March 2, abstracts from the "Wied. Ann." a paper by Messrs. Ebert and Wiedermann.

Propagation of Electromagnetic Waves.—"L'Elec.," Feb. 24, and "L'Ind. Elec.," Feb. 25, reprint in abstract an Academy paper of a mathematical nature by Prof. Mascart.

A New Electrical Theorem.—In a Physical Society paper abstracted briefly in the Lond. "Elec." and Lond. "Elec. Eng.," March 2, Mr. Blakesley gives a theorem regarding two or more dispositions of electromotive forces in any network of conductors.

Radiation.—The "Elek. Zeit.," March 1, abstracts a paper by Mr. Lenard from "Wied. Ann.," page 225, in which he describes researches with his tubes containing a "window" of thin aluminium foil.

Piezo Electric Phenomena.—An article by Mr. Somigliana is abstracted in part in "La Lum. Elec.," Feb. 24.

Conductivity of Discontinuous Conductors.—An Academy paper of Mr. Branly is abstracted in "L'Ind. Elec.," Feb. 25; he describes experiments made with pulverized materials.

Influence Machines.—"La Lum. Elec.," Feb. 24, contains a note regarding some improvements.

MAGNETISM.

Reflection of Magnetism.—In the discussion of Mr. Kapp's paper, abstracted elsewhere, Prof. Silvanus Thompson stated that a large sheet of iron not less than 10 millimetres thick acted toward all the things that might be placed in front of it as a magnetic mirror giving negative, but not positive images; an illustration is given in the Lond. "Elec.," March 2; if this sheet of iron is placed in front of the end of a coil the effect is the same as if there were no sheet, but as if the coil were double the length; that is, as if the coil and its image (on the other side of the screen) were both at work, doubling the action of this coil; if two such sheets were placed at the two ends the effect is analogous to a candle between two mirrors, thus producing an endless row of coils, or practically an endless straight coil.

Magnetism and the Makers of Iron.—Mr. Evershed in the Lond. "Elec.," March 2, discusses this subject without, however, giving anything new; he states that the hope that by further purification of the iron hysteresis might be eliminated entirely, is almost certain to prove illusory, as hysteresis is a property inherent in a group of magnetic molecules; a far more important matter for iron makers is to supply a uniform quality rather than iron of absolute purity; to builders of dynamos and transformers his recommendation is to make frequent tests.

Sun Spots and Magnetic Disturbances.—A paper by Dr. Palazzo from the Italian, published in "Nature," volume 22, page 189, is abstracted briefly in the Lond. "Elec.," March 2; he discusses the relation between the two phenomena, and concludes that the connection between them is by no means a simple one.

Magnetic Induction.—The "Elek. Anz.," Feb. 25, contains another article by Mr. Schwartze, in which he criticises unfavorably the usual formulas for magnetic induction.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing the Magnetic Qualities of Iron.—Mr. Kapp's paper, mentioned in the Digest last week, is reprinted in the Lond. "Elec. Rev." and Lond. "Elec.," March 2, the latter journal containing also an illustrated report of the discussion; the illustrations of the paper are given best in the Lond. "Elec. Eng.," March 2, which are reproduced here. His aim was not absolute accuracy, but more a method which can be used by any one in the laboratory; it has been in use for some years and has given results which have always been sufficiently accurate for practical purposes. For testing iron bars he uses a modified form of the Thompson permeameter, in which the induction through a sample bar is measured by the force required to pull it away from another piece of iron; as the induction is proportional to the square root of this force, any small error in the measurements results in a still smaller one in the induction; his object was to make the corrections both small and definite; as will be seen from Fig. 1,

it consists of a heavy rectangular frame of Lowmoor iron well annealed, within which is a fixed solenoid with a subdivided winding, so that a variable but known number of turns can be placed in circuit, the object being to keep the current within limits between which it can be measured accurately; the sample consists of a bar accurately turned and faced at the lower end, it is larger at the upper end, where it makes a tight fit, and is centred at the lower end by a gun metal ferule; a movable plunger at the bottom contains a scale pan for the weights; the correction due to the air space, which is the most important one, can be easily calculated and the others are quite trifling; for inductions above

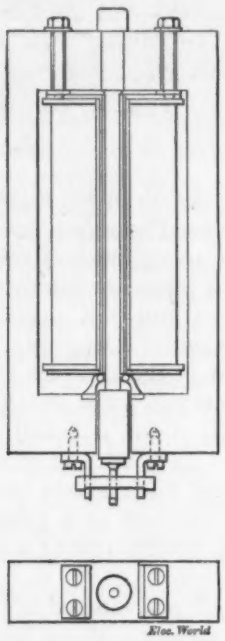


FIG. 1.—TESTING MACHINE FOR IRON BARS.

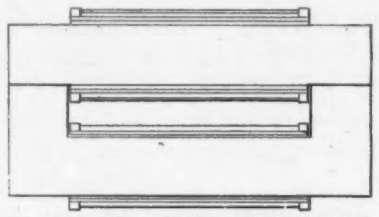


FIG. 2.—TESTING MACHINE FOR TRANSFORMER PLATES.

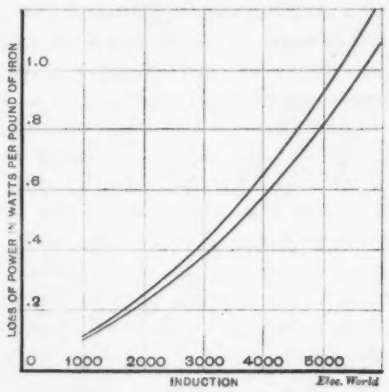


FIG. 3.—DIAGRAM SHOWING AVERAGE RESULTS OBTAINED IN TESTING SAMPLES OF PLATES.

10,000, even the former becomes relatively small, and above 15,000 quite negligible; it is necessary to use a storage battery, as a dynamo current is too varible; the greatest weight supported by a half-inch sample bar of good iron is about 45 pounds; the time occupied for a test through a complete cycle is about one hour with two men. For testing transformer plates the apparatus in Fig. 2 is used, consisting essentially of a closed magnetic circuit, as shown, the sample plates being the straight upper pieces, which are laid together to make up a certain weight and inserted through the top coil, being fixed by wooden wedges, the coils being connected to a sine current through a wattmeter; the instrument is calibrated once for all by making the sample and the permanent part of the same quality of plates and then apportioning the losses according to their weights; with other samples from the loss measured by the wattmeter this constant portion is deducted, the remainder being the loss in the sample, a correction being made for the loss due to ohmic resistance, which, however, is exceedingly small; as before, the coils are sub-divided; the resistance of the joints is immaterial, as it influences only the current, but not the power. Two curves are given in Fig. 3 for the mean and the minimum induction and the loss of power in watts per pound; within thicknesses between 10 and 13 mils, the thickness has only a very small influence on the loss, which confirms Ewing's investigation, from which he concluded that there is no advantage in going below 13 mils. He discusses also the method of making up a complete transformer with sample plates, but concludes that besides being expensive it is very uncertain, as the test includes that of the complete transformer and is not that of the iron alone.

In the discussion Prof. Hughes and others brought up the objection to the contact between the two pieces of iron. Prof. Thompson believed that his (Thompson's) later form was even better than Kapp's; he tries to avoid sources of correction, and makes the cross-section of the yoke pieces 200 times as great as that of the test rod, the latter being made longer and thinner than in Kapp's instrument to diminish the error of contact, the rupture taking place between the sample piece and the yoke; he suggested a method for testing iron in large blocks by means of two small coils embedded in a strip of ebonite, acting as a sort of transformer; this is laid on a block of iron and a magnetizing coil is applied; it was a mere suggestion. Mr. Steele called attention to the importance of selecting a proper sample from which the skin had all been turned away; to get rid of contact resistance he suggests using a small cap. Dr. Fleming suggested that unless the iron was tested in the form in which it was to be used, the test would not be conclusive; he showed that eddy currents in a transformer plate might circulate in the plane of the plate; also that the loss in the iron seemed to depend on the E. M. F. of the curve; it would be of great importance to ascertain whether it was not possible to get rid of hysteresis altogether. Mr. Sparks thought that the results for a sample bar would not be the same as that of the iron in the machine. Prof. Perry did not approve of Thompson's proposed methods, as there was no saturation and no permeability; he called attention to the fact that the lifting power is greatly increased by reducing the area of contact. Mr. Mordey stated to have had great trouble in obtaining an even quality of iron; in his specification he adopts the standard of 2,500 lines per square centimetre and a loss at 100 periods of 0.38 watts per pound, a standard easily worked to; 0.25 and 0.28 have been obtained; the variation was 60 per cent. above the standard, even in the same case of iron; chemical analysis was absolutely no guide; the power factor varied all the way from 0.6 to 0.9 with the same hysteresis; he had found great difficulty with the contacts. Mr. Ravenshaw called attention to the importance of testing armature iron, stating that the hysteresis loss had been found to be twice as great in bulk as in samples. Mr. Siemens described the method used in Woolwich, which, he claimed, was much simpler and safer; it was based on that of Prof. Ewing, the apparatus consisting of a brass tube 3 feet long and 3-4 inch internal diameter, over which a coil was wound and connected to a rheostat and double key with a 10-volt battery, an exploring coil connected to a galvanometer encircled the middle portion; by this method the hysteresis curves were plotted, the iron, which must be shorter than the tube, being placed in the inside; the area of this curve gave the quality of the iron; if the piece of iron was smaller, the curve would be inclined, but its area remained the same; there was no fitting whatever; it takes one man a quarter of an hour to make a test. Mr. Kapp, in replying, agreed that the difficulty was in the contact, but stated that for high inductions this did not make much difference. "Ind. and Iron," in an editorial, states that the methods are quite old and that the real drawback was in the pull being too large, and that if the induction is not perfectly uniform over the contact surface, it could not be determined from the pull. In an editorial discussion, the Lond. "Electrician" does not think that Mr. Kapp has solved the problem satisfactorily, the objections being due to the joints; attention is called to the neglect of testing of armature iron, and it does not believe his methods admit directly of the determination of the permeability of the armature, on which it is claimed the characteristic of a machine depends to a large extent; it believes that none of the methods discussed appear to be quite perfect. Some further extracts from the discussion will be found under "Transformers" and "Magnetism."

Photometers.—A well-illustrated description of Mascart's photometer is given in "La Nature," Feb. 24; also a novel form of photometer devised by Mr. Henry, intended spe-

cially for very dim illuminations; a tube resembling a small telescope contains two semi-circular screens, one of ground glass permitting the light which is measured to pass through; the other is covered with phosphorescent sulphide of zinc; a short piece of magnesium wire of fixed dimensions is placed in front of this screen; the burning of this illuminates the phosphorescent screen; with a stop watch the time is then measured after the light is extinguished and until the two screens have the same illumination; from a curve the illumination is found which corresponds to this time.

Attachment of Quartz Fibres.—In a Physical Society paper, abstracted in the Lond. "Elec." and Lond. "Elec. Eng.," March 2, Prof. Boys describes in detail a method of soldering the ends of such fibres; the ends are silvered and electrocoppered, after which they are soldered to a piece of metal; if they are required to conduct electricity, as in electrometers, they are afterward silvered.

Ampere- and Voltmeter.—According to an illustrated description in the "Elek. Zeit.," March 1, the Wilkins' apparatus consists of a thermometer tube with a large bulb at each end containing a gas, the tube itself containing a short column of mercury; a shunt or series coil in the interior or around the outside of the lower bulb heats the air, driving the mercury indicator to various positions, which are said to represent a measurement of the current or the voltage.

Temperature Coefficient of Copper.—The Lond. "Elec. Rev.," March 2, in an editorial abstracts the Congress paper of Messrs. Kennelly and Fessenden, criticising it and suggesting that the fact that different samples of copper may behave differently might account in part for the apparent ambiguity between the results of different experimenters.

Electrodes for Measuring the Resistance of Electrolytes.—The "Elek. Zeit.," March 1, abstracts a paper from "Wied. Ann.," page 346, by F. Kohlrausch, in which he describes some forms of electrodes for this purpose.

Testing Circuits.—In Mr. Guy's serial in the Lond. "Elec. Eng.," March 2, he discusses this subject.

DYNAMOS AND MOTORS.

Alternators in Parallel.—In the Lond. "Elec. Eng.," March 2, Mr. Proctor, of the Bristol station, describes with the aid of a diagram the method which he uses and with which he has never had any difficulty, and which, he claims, renders an accident impossible. It consists essentially in connecting the alternator to the synchronizing apparatus and when synchronism is obtained connections are made with the mains through a synchronizing fuse, which will blow if the synchronism is not successful; if it does not blow, the permanent connection may be established; the switchboard arrangements are such that the same fuse is used for any of several alternators. He states that they should be connected when the synchronizer is on the increase, never when it is decreasing, and preferably not when it is stationary; the only inconvenience experienced was due to the loaded machine being too much overloaded to keep a constant speed.

Armature and Field of Rotary Field Motors.—In a brief discussion in "L'Ind. Elec.," Feb. 25, regarding the question of how these terms should be used, it suggests that all confusion could be avoided by using the French terms "inducteur" for the part which produces the inducing field, constant or not, and "induit" for the part in which induction takes place; it also mentions the words "stator" for the fixed part and "rotor" for the movable part.

Unipolar and Non-Polar Induction.—The discussion in the "Elek. Zeit.," March 1, is continued by an article by Prof. Vogel and another by Mr. Marcher; it is, to a great extent, personal, each one declaring the other to be mistaken; according to a note from the editors that discussion is herewith closed.

Theory of Alternating Current Motors.—"La Lum. Elec.," Feb. 24, contains a mathematical article of some length by Mr. Guilbert.

TRANSFORMERS.

Short Circuiting in Coils.—Mr. Steele, in discussing Mr. Kapp's paper, abstracted elsewhere, described a method of detecting short circuits, consisting of suspending a rod of iron horizontally and moving it in the direction of the leakage lines; if any turns are short circuited, leakage will be produced and the iron rod will suddenly dip, being attracted to the point of short circuit; to determine whether it is in the primary or secondary coil, each one is tested separately.

Leakage in Transformers.—In Mr. Kapp's paper on testing iron, abstracted elsewhere, he calls attention to the fact that the losses in a transformer become less after some weeks of use, which he believes to be due to the coils having become thoroughly dried; this loss in the primary coils due to leakage is quite appreciable when compared with the true iron losses.

Efficiency.—Mr. Steele, in discussing Mr. Kapp's paper, abstracted elsewhere, stated that much improvement had recently been made in the efficiency of transformers, the (iron?) loss in the Kapp transformer being only 0.95 per cent. at full load, the full load efficiency being 97.4; a table is given for the iron losses and efficiency of several Kapp transformers.

ARC AND INCANDESCENT LIGHTS.

Illumination.—In a recent lecture on "Illumination and Nearsightedness," by Dr. Cohn, abstracted in the "Elek. Anz.," March 1, he shows that nearsightedness is often due to poor illumination; 10 metre candle (equal to very nearly one candle at one foot) he gives as the minimum illumination which should be used for reading; daylight at an open window is equivalent to about 300 metre candles (equal to about 28 candles at one foot); he concludes that the only suitable light which should be used in the future is the electric light. Mr. Henry, in "La Nature," Feb. 24, also gives the same figure for a minimum illumination for reading and writing without fatigue to the eyes; for normal daylight on a well exposed surface he gives 50 candles at one metre (equal to about 4.7 candles at one foot); for the light of the sun he gives 50,000 candles at one metre; the smallest illumination that can be detected by the eye, he says, is the equivalent of one candle at a distance of 3.4 miles.

Relative Light and Power of Gas.—In the "Elek. Anz.," Feb. 22, Mr. Schwartze abstracts Mr. Bourquin's recent article mentioned in the Digest some time ago, showing that more light can be obtained by using the gas in gas engines for generating electric light than by burning it directly.

Colored Photography.—According to "La Lum. Elec.," Feb. 24, the electric light can be used in this process.

TRANSMISSION OF POWER.

Rotary Phase Transmission.—In a recent lecture by Prof. Silvanus P. Thompson, abstracted in the Lond. "Elec. Rev.," March 2, and commented on editorially in the Lond. "Elec.," March 2, he showed some interesting experiments, one of which was to place an ordinary porcelain plate in the centre of a horizontal Gramme ring without commutator or shaft, on which is placed a large hollow copper egg; on generating a rotating field by means of a three-phase current, the egg rotated and finally spun on its end. In another experiment, which is more novel, a horseshoe magnet was rotated, a sheet of copper was cut with two slots lengthwise so as to form the equivalent of three parallel conductors having common connections at their ends; on placing one of the ends of this over the rotating magnet, a magnetic needle placed over the other end began to revolve, thus illustrating in a simple way the transmission of power by three-phase currents; the apparatus is illustrated in the Lond. "Elec. Rev."

ELECTRIC RAILWAYS.

Liverpool Overhead Railway.—Two papers, one by Messrs. Greathead and Fox and another by Mr. Parker, are given in abstract in the Lond. "Elec." and Lond. "Elec. Eng.," March 2; the former deals with the civil engineering features and the latter with the electrical features. In the latter the mean value of seven tests gave an efficiency of 88 per cent. between the indicated horse power and the electrical horse power on the line; on a run of 5 1-8 miles in 24 minutes 57 seconds and in another in 23 minutes and 47 seconds, with stops of 25 seconds at each station, the power required was 44.4 indicated and 46 electrical horse power respectively; the effect which a large number of trains had in bringing down the maximum current per train was very apparent, with seven trains it was twice and with twelve trains only one and a half times the average current per train, the average demand for power, continuously, being 37 electrical horse power per train; when seven trains were running, the coal used was 22.5 pounds per train mile and for the later summer months about 17 pounds; the actual working costs for the later summer months were a little less than 8 cents per mile; it was found that the line could be run at a cost well within that guaranteed by the contractors.

Cost of Traction in Marseilles.—According to "L'Ind. Elec.," Feb. 25, the accounts of the Marseilles railway, which was constructed by a French and a Swiss company, show that the cost of traction, including wages, power, repairs and maintenance, exclusive of the road, is 22.4 cents per car mile.

Regulations.—A report of the discussion of the Board of Trade rules is given rather fully in the Lond. "Elec.," March 2, and in abstract in the Lond. "Elec. Rev." The subject is discussed also in a long editorial and in some notes in the Lond. "Elec.," March 2.

Underground Railway in Budapest.—Some further details regarding this proposed road are given in the "Zeit. fuer Elek.," Feb. 15.

Electric Parcel Wagon.—According to the Lond. "Elec. Eng.," March 2, parcel vans run by storage batteries are to be introduced in London; the working cost for a two-horse vehicle will be 4 cents per mile, one charge being capable of running thirty miles.

Heilmann Locomotive.—The Lond. "Elec. Rev.," March 2, gives a well illustrated description, being apparently a translation of the one of Mr. Hospitalier, already mentioned in these columns. In a communication of Mr. Lea, in the same issue, he replies to the recent criticisms of that journal. "La. Lum. Elec.," Feb. 24, contains a very well illustrated description.

Long Trolley Wires.—Several of the German journals call attention to the fact that a German wire firm, Hesse & Sons, have succeeded in making single lengths of trolley wire weighing 3,300 pounds.

Genoa Railway.—The description in "La Lum. Elec." is concluded in the issue of Feb. 24.

Railways.—Mr. Richard's profusely illustrated serial, taken apparently from patent specifications, is continued in "La Lum. Elec.," Feb. 24, the greater part being devoted to trolleys and their details.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Balancing a Three-Wire Station with One Machine.—Mr. Thursfield, in a communication to the Lond. "Elec. Rev.," March 2, discusses the scheme of Mr. Gibson, abstracted in the Digest last week, stating that the chief difficulty with two armature windings is that the relation between the E. M. Fs. of the two armatures is necessarily constant and that it is impossible to produce anything but an approximately equal E. M. F. on each feeder, and that the only way in which its regulation could be effected with that apparatus would be by connecting the generator armature on to the charging switches and the feeders on to the discharging switches; this entails putting the whole load of the station through a part of the batteries, which is out of the question; with the arrangement at the Burnley station (illustrated in the Digest March 3), it is not necessary to put more than half the current in the balancing wire through the batteries.

Central Station Apparatus.—The Lond. "Elec. Rev.," March 2, gives short illustrated descriptions of some of the new apparatus introduced by the English Brush company, which are said to be improvements of an important character, the object being the simplification of central station working and the reduction of risk of accidental stoppages due to carelessness. Among these is the Raworth automatic switch gear for coupling continuous current dynamos in parallel; another is an interlocking switching gear for alternators in parallel, the switch of which cannot be closed until the field and the synchronizing switches are closed and the field fully excited; another is his interlocking switching gear for main feeders; the return current fuse, mentioned in the Digest last week, is also illustrated and described; a universal contact offering a number of advantages is shown and described; it consists essentially of a hollow casting cut lengthwise so as to form a large number of independent spring contacts with large bearing surfaces; an automatic regulator for the Brush dynamo field is described, in which the movements of a lever vary the immersion of plates in water, thus varying the resistance; a device by Mr. Mordey is mentioned for automatically adjusting the brushes of a Brush machine for changes of load, an adjustment which is usually made by hand.

Switchboard.—The large new switchboard for low-voltage continuous currents, just installed in the Carnaby station, which is claimed to be one of the best and most compact, is described and illustrated in the Lond. "Elec. Eng.," March 2.

Switching Dynamos in Parallel.—The apparatus by Mr. Brenner, of Montreal, is described and illustrated in the Lond. "Elec. Rev.," March 2.

First Three-Phase Plant in the United States.—Mr. Jennings, in the Lond. "Elec. Rev.," March 2, calls attention to the fact that the first transmission plant in the United States was at Rock Creek, Cal., designed and constructed by Messrs. Pearson & Keith, of San Francisco, in 1890, a description of which was contained in the "Mining and Scientific Press," of San Francisco, Jan. 3, 1892.

Stockholm.—The "Elek. Zeit.," March 1, gives a long description of this continuous current, three-wire system, in which accumulators are used; it contains a large number of well selected illustrations showing numerous details and views.

London.—Major General Webber's paper is continued in the Lond. "Elec. Rev." and Lond. "Elec. Eng.," March 2, and concluded in the Lond. "Elec.," in which the discussion also is given.

Nottingham.—The description of this plant is concluded in the Lond. "Elec. Eng.," March 2, in which a large number of illustrations of the architectural features are given.

Isolated Plant in France.—"L'Elec.," Feb. 24, gives a description of a small accumulator plant, which is claimed to have been very well designed; several good illustrations are given of the principal connections.

Central Stations.—"L'Ind. Elec.," Feb. 25, publishes as a supplement under separate cover the very complete table of statistical information regarding central stations in France at the beginning of the present year, which table was noticed in the Digest Feb. 24.

Electric Elevators.—It has been proposed to erect elevators between the low and the high portions of the city of Berne; with these, 8 h. p. obtained from water power can

transport 1,900 persons a day through a height of about 90 feet.

Central Station Engines.—The Lond. "Elec. Rev.," March 2, contains a number of communications by engine builders and others.

Evaporative Condenser.—The Lond. "Elec.," March 2, gives an illustrated description of a form used on the Continent.

Steam Turbine.—"La Nature," March 3, contains a well-illustrated description of the Laval steam turbine.

WIRES, WIRING AND CONDUITS.

Electric Lighting of Ships.—Mr. Muitt in the Lond. "Elec. Rev.," Feb. 23, does not agree with Mr. Kennedy in advising the adoption of single wiring and that compasses are not affected any more than by double wiring; he refers to experiments, which he describes and which show that this does not appear to be the case; it has been found that on some ships where the single wire has been used, disturbances of the compass from 3° to 7° occur when groups of lights are thrown on and off; he advocates strongly the double wire system, which has also other advantages. The Lond. "Elec. Rev.," March 2, contains a number of communications on this subject; Mr. Martin states that after ten years' experience with over 200 vessels, he has no hesitation in saying that the single wire system is far more troublesome and more liable to cause fires; armored wire exposed in any way stood little better than good teak casing, which latter, he says, if properly put up stands as well as anything that could be used, provided galvanized iron pipes are used in parts where the wire might be exposed to moisture; he criticises Mr. Kennedy's devices, mentioned in the Digest last week, stating that much trouble has been caused with these improved fittings, the fault being invariably in the fitting or back block, even in the installations made by Mr. Kennedy himself; in conclusion he recommends strict supervision and frequent tests by inspectors. Mr. Kennedy, in replying to the criticism of Mr. Muitt, mentioned in the Digest last week, states that it does not prove much one way or the other, as leads are never run in the way they were in those tests. Mr. Walker thinks most of the trouble lies in the acceptance of the lowest bid, which generally means poor workmanship.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Signaling Wihout Wires.—The Lond. "Elec. Eng," Feb. 23, abstracts a Society of Arts paper of Mr. Preece, in which after referring to the experiments described in his recent Congress paper, he mentions a series of experiments made near Frodsham, the very satisfactory results of which will shortly be published: he states that given the localities between which it is desired to communicate, it is a mere matter of calculation to show what is to be done; it will be quite easy to speak between France and England across the Straits; ordinary apparatus was used and it was found that speaking by telephone across a space of 1 1-4 miles was practicable and easy, the sounds being so loud as to be sufficient to form a call; the apparatus consisted of 100 dry cells, a rapidly revolving rheotome and a Morse key; two Bell telephones joined in parallel acted as receivers; for transmission of speech, granular carbon microphones were used, through which a current of two amperes was maintained. He believes to have shown that earth conduction was not the principal factor; he found that the apparatus worked best for one particular frequency, proving the presence of resonance, but this effect far exceeded in magnitude that due to the natural pitch of the disc; conversation by telephone was possible but not practicable. In conclusion, he refers to cosmical electricity, stating that "it is not a wild dream to say that we may hear on this earth a thunderstorm in the sun." The paper is given also in abstract in the Lond. "Elec. Rev.," March 2.

Multiple Switchboard of Great Capacity.—"La Lum Elec.," Feb. 10, gives a short description of a new multiple switchboard serving for 30,000 and even 48,000 subscribers, said to be "astonishingly simple in its construction," one switchboard for telephonic service, by Mr. Sieur, which is while the largest at present in use is said to be for 6,000; owing to the want of a figure, the description is not very clear; it is taken from "Jour. Teleg.," the date of which is not given.

Pacific Cable.—The Lond. "Elec. Eng.," March 2, contains a note and an editorial on the proposed all British Pacific cable.

Communications between England and India.—In the Lond. "Elec. Rev.," March 2, Mr. Walker gives a further communication on this subject.

Telephone in Europe.—The "Jour. Teleg." for February gives in detail the charges in a number of European countries; the "Elek. Anz.," Feb. 22, contains a short article on this subject consisting of a brief summary.

Bronze Wires in Telegraphy.—The "Jour. Teleg." for February contains an article by Mr. Buels in reply to one by Mr. Miller.

ELECTRO-CHEMISTRY.

Purification of Sugar.—The "Elek. Rund.," No. 9, states that Mr. V. Lippman experimented with an electric process in a French beet root sugar factory; the juice is treated with a current of 30 to 40 amperes and 4 to 5 volts between electrodes of zinc, the albumen is thereby coagulated, carrying down the impurities as does also the zinc oxide which is formed, leaving the juice free from zinc; an important advantage of this process is that it avoids the necessity of heating the juices, which is apt to be injurious.

According to "La Lum. Elec.," Feb. 10, Mr. Dupont, a chemist, has shown that with a liquor having a coefficient of 23 and a degree of purity of 83, he has obtained by an electric process a coefficient of 200 and a degree of purity of 99.5 and even more, the cost not being greater than that of the usual process; further information is promised.

Purification of Lead.—Lond "Elec.," Feb. 16, describes briefly a process for the recovery of the silver and the production of chlorine; chlorides of calcium and magnesium are decomposed with lead nitrate; from the lead chloride so produced chlorine is obtained by electrolysis, while the nitrates are heated for the recovery of the nitric acid, which is used to dissolve the crude lead forming lead nitrate; silver is precipitated from this by the addition of spongy lead.

Is Chemical Change the Reverse of Electrolysis?—In an editorial on this subject the Lond. "Elec. Rev.," March 2, discusses Mr. Veley's paper in the "Phil. Mag."

MISCELLANEOUS.

Harmlessness of High-Tension Currents.—According to an editorial in the Lond. "Elec. Rev.," March 2, Mr. Blakesley says that the energy of the discharges is mostly expended in radiation which the human body does not check and not in current through the body; Prof. Lodge argued that no serious consequences followed when Mr. Tesla passed his currents through his body, because there was not much energy behind them.

Mine Exploders.—"L'Ind. Elec.," Feb. 25, publishes a well illustrated description of the Manet system, in which a hand driven, self-exciting dynamo is used for generating the current (we understand that this system is used largely in France).

English Patent Office.—The Lond. "Elec, Eng." March 2, suggests some needed reforms, making it more like the system in this country.

French Tariff.—In "L'Elec.," Feb. 24, Mr. Haubtmann gives a resume of the French duties on electric goods.

Judge Ricks' New Opinion.

By a decision rendered Tuesday of last week Judge Ricks, of Cleveland, Ohio, denied the motion of the Universal Electric Company to dissolve the existing injunction obtained against it by the Edison Electric Light Company, restraining the Universal company from infringing the Edison lamp patent. The Universal company moved to dissolve the injunction on the grounds that by reason of a certificate attached to the Edison lamp patent in 1883, which referred to certain foreign patents for the same invention, that patent expired with the English patent last November, or, at any rate, that the Edison company was estopped from contending that it did not then expire.

Judge Ricks, in his opinion, states that as it is conceded by the defendant's counsel that the motion in this case is a close copy of the similar one filed by the Buckeye Electric Company, frequent references will be made to that case, and he proceeds to compare the two. In the Buckeye case the defendant company was organized in February, 1890, just after Justice Bradley had decided that the Sawyer-Man patent was invalid, and when the belief was genera' and had a substantial foundation that the Edison patent would likewise be held invalid. In the early stages of its business there was no adjudication showing the Edison patent valid and about the same time it had learned of the correction on the Edison patent limiting its life. Further, that there had been negotiations between the Buckeye and Edison companies with a view to consolidation and at the same time a substantial acquiescence in the defendant's infringement was fairly inferable from the acts and conduct of the complainants, and that the investment of the defendant had been largely increased prior to the plaintiffs' revocation of their endorsement limiting the life of the Edison patent. As a consequence the Buckeye company was not at any time a wilful infringer, but had made all of its investments in good faith previous to Judge Wallace's decision.

In the case under consideration, the Universal Electric Company was organized in August, 1892, more than a year subsequent to Judge Wallace's decision and only a few months prior to its affirmation by a final court. Its increased investments seem to have been $9,000 and $10,000 in January, 1892, and May, 1893, respectively, the latter subsequent to the date of the complainant's attempted revocation of its grant to the public. In the Buckeye case the court found that the company acted in good faith, relying upon the acts and conduct of the complainant, and that all of its investments were prior to the revocation. While the court declined to say just what rights the public acquired as against the Edison patent in virtue of the voluntary limitation of its life, it did find that the Buckeye company had acquired vested rights that could not be disturbed. In the present case, however, the defendant began business as an infringer, and their last investment was made after the revocation of March, 1893. Again, if the present defense had been offered against an injunction it would not, unlike the Buckeye case, have availed. It could not have shown any such conduct or acts on the part of the complainant as estopped it from claiming the benefits of its revocation of March, 1893, as the Buckeye company could have done in its case, and for these reasons the court did not think the defendant had made a case entitling it to dissolution of the injunction now in force.

Having decided the case upon the facts, and for the reasons stated, the court did not think it necessary to notice the further contentions made on behalf of the complainants, as follows:

(1) That the proceedings in the Patent Office of December, 1893, were entirely void for want of jurisdiction of that office, and that therefore the record made by the office in those proceedings was not a record of which the public were obliged to take notice, and could not be operative, either upon the complainant or upon any one claiming rights thereunder by reason of the complainant's conduct.

(2) That the proceedings in the Patent Office of December, 1883, were not binding upon one of the complainants in this case, to wit: The Edison General Electric Company, because, at the time said proceedings were instituted, the said Edison General Electric Company had a license from the patentee and his assignee to manufacture under said patents, which license ran to said company, and certain other associates named, and that they could not be influenced or affected by such proceedings in the Patent Office of which they had no notice, and that the interest of the Edison General Electric Company was acquired by it from the owners of the patent prior to any investments made by the defendant in this case.

The court said that both of these propositions, pressed with great earnestness by the learned counsel, might be of very great importance in connection with the case if presented in a different phase; but, as before said, it was now not necessary to consider them in connection with the decision based upon the facts as stated.

Storage Batteries.

We have received an interesting communication from Mr. Alfred Clarke, general manager of the Eastern Electric Light and Storage Battery Company, of Lowell, Mass., in which he refers to the recent paper on storage batteries contributed by Prof. Elihu Thomson to our issue of March 3 as a valuable contribution on the subject and one to be commended to every one interested in storage batteries. He states that the conclusions, being the result of careful investigation, confirm in every way his own experience in the manufacture, use and abuse of the storage battery, but that there is one point that Prof. Thomson omitted, to which he calls attention, as well as to qualify one of the statements in reference to the dangerous condition of sulphation of batteries under certain conditions. "Prof. Thomson states that 'the most economical rate of charging is a low rate.' This is true to a certain extent, but there is a limit to a low rate of charging. Too low a rate instead of peroxidizing the positive plate will produce the dreaded sulphate of lead and should be guarded against. Gladstone and Tribe in their researches in the chemistry of the storage battery discovered this fact, and recorded it in their valuable work on the subject, and I take the liberty to quote page 11: 'If we take two plates of lead in dilute sulphuric acid and pass a current from only one Grove cell a film of white sulphate, instead of peroxide, makes its appearance on the positive pole, and the action practically ceases very soon. If, however, the current is increased in strength, the sulphate disappears and peroxide is found in its place.' My experience confirms this: hence the danger in attempting to charge a secondary cell from primary cells. To state the matter broadly, a secondary cell ought not to be charged at a lower rate than one-thirtieth of its normal capacity. The best charging rate is from one-tenth to one-eighth. Hence care should be taken in charging with primary cells to ascertain the normal capacity of the secondary cells which will determine the number of primary cells requisite to charge the secondary. The above applies to any means of charging; therefore it is well to remember that there is a limit to the charging current; to go below is positively detrimental."

Mr. Clark also refers to the name "storage battery" as a misnomer, and to the misleading character of the usual analogy with a water tank, in not giving the proper idea of the nature of a storage battery, which, he says, is a chemical combination whose molecular equilibrium is alternately disturbed and restored by an electrical current. Referring to the bright prospect of the storage battery in this country, he says that hitherto its powers have been overestimated

and capacity strained, but that since manufacturers honestly engaged in the business have become conservative in their claims, its applications have begun to extend. Mr. Clark thinks that in view of the successful era about dawning the appearance of a recent challenge from a storage battery manufacturer, which was published in our columns, is unfortunate, not only from its tone, but, as he thinks, from its being apt to mislead and react unfavorably on the public.

A Modern Lighting Plant.

The new electric light plant recently installed at the State Hospital for the Insane at Norristown, Pa., by Harry S. Smith & Co., Limited, of Philadelphia, was turned over by the contractors to the trustees on Feb. 5. The plant has been in operation several weeks and has proved satisfactory in every respect. The plant consists of two direct coupled 125-h. p. units. The dynamos are of the well-known Waddell-Entz type, with external armature of large diameter, enclosing internal field magnets, energized by a single coil of wire supported upon the hollow core joining the front and back magnets, in this case the machines having 10 poles. In these machines the commutators are of an unusually large diameter and with the brush holders and special brush raising and shifting devices are of the latest improved type.

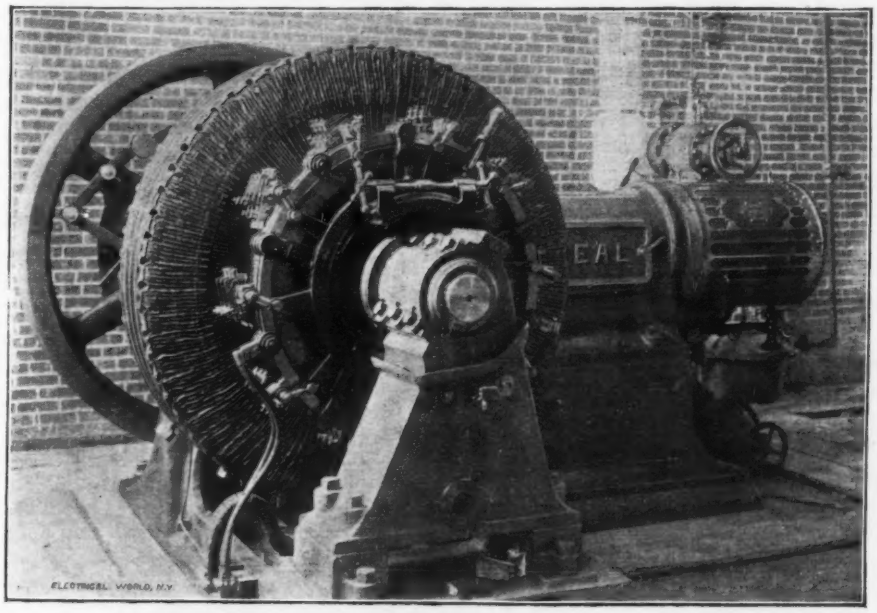


FIG. 1.—DIRECT-CONNECTED ENGINE AND DYNAMO.

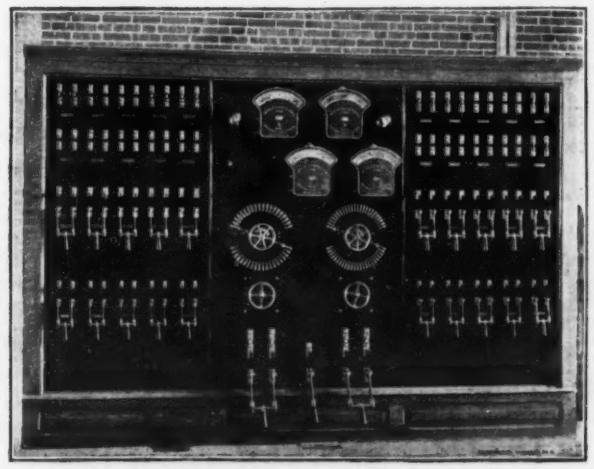


FIG. 2.—THE SWITCHBOARD.

These latter devices are so arranged that the brushes can be shifted individually or collectively, each separate brush being capable of adjustment on the commutator. Woven wire gauze brushes are used on both machines. The dynamos are direct connected to two 16 inches by 16 inches Ideal engines manufactured by the Harrisburg Foundry and Machine Works, each engine developing 138 indicated horse power at 250 revolutions.

The engines are furnished with extended shafts of large diameter, each made in one forging, extending through the hub of the armature spider to an auxiliary bearing, the hub being rigidly fastened to the shaft by keys. The engines are especially heavy in construction and together with the dynamos are mounted on heavy cast iron sub-bases of special design. The engines are self-lubricating and the pillar blocks are cast with troughs to catch and carry off oil drippings.

Fig. 1 gives a view of one of the engines and dynamos. Provision has been made for two additional engines and dynamos to complete the plant.

The dynamo connections are lead encased and carried to the switchboard in ducts built in the floor. The switchboard consists of three panels of black enameled slate mounted in a framework of polished oak. On these panels are mounted the instruments and switches controlling the different circuits. Besides the dynamo switches there are twenty circuit switches to control the lighting of the different buildings, all switches being polished. Each dynamo is furnished with a voltmeter and ammeter. An additional ammeter and voltmeter are so arranged with shunts and switches that the voltage and number of amperes of any of the twenty circuits can be taken at the switchboard. The instruments are station size, with illuminated dials, manufactured by the Weston Electrical Instrument Company. In Fig. 2 is shown the switchboard, one of the instruments having been removed for recalibration.

The plant was installed under the supervision of Dr. W. A. Drysdale, consulting engineer, and no expense has been spared by the contractors to make the installation complete in every way.

The Monthly Meeting of the Massachusetts Street Railway Association.

The monthly meetings and dinners of the Massachusetts Street Railway Association have always been interesting on account of the discussion of practical subjects by practical men, and the one which occurred on Thursday afternoon, March 8, at Young's Hotel, Boston, was not an exception to the rule. The special subjects for discussion were "Car Wheels" and "Brake Shoes."

Col. J. H. Cunningham, president of the Association, introduced as the first speaker Mr. W. W. Sargent, superintendent of the Fitchburg and Leominster Street Railway Company. Mr. Sargent stated that when his road first adopted electricity they used a wheel made by a New York firm which had given good service; they were now, however, trying some of a different make. The brake shoes they had cast at a local foundry. A soft shoe was used for the reason that it brakes a car more quickly and requires less power for application than a hard shoe. It is necessary, however, to caution the motorman against skidding the wheels. The use of such a shoe also does away more or less with reversing the motor, which is so injurious. In the matter of brake apparatus he suggested the use of a complete auxiliary brake, operated from either end of the car, without the motorman changing his position. Most accidents, especially calamity accidents, occurred by reason of the brake giving way. An emergency brake would undoubtedly overcome this difficulty.

Mr. Benjamin J. Weeks, of the Boston and Quincy Street Railway Company, stated that he had tried all kinds of wheels and up to last winter had used nothing but the ordinary 30-inch wheel, 2¼ tread, weighting 325 pounds. Last fall his attention was called to a new style of wheel, the flange of which was cogged, and putting four of these under a single plow he was able to keep his line open with this one plow, the cogs on the flanges acting as cutters. He experienced no difficulty whatever from the wheels slipping. Several raidroad men had been out to see the plow and a trial had been made on solid ice, the plow going on the ice almost as well as on the rail, there being very little slipping. In one instance, the plow was halfway between Quincy and North Weymouth when the armature burned out and they came back with one motor, plowing the snow, which was 8 inches deep all the way. He now has a set of these wheels under a box car and has no doubt that they are the coming wheel. In regard to brake shoes, he thought that price was not everything. The ordinary iron shoe if low-priced must necessarily be made of cheap material. If it is tolerably hard metal, it will glaze over and fail to hold the car. If the metal is very soft it is at the expense of the wheel, as it will work very much like a soft grindstone and what may appear to be the most economical shoe will prove the most expensive. In the fall of 1892 he tried one of the Safety Brake Company's shoes with wooden plugs, and the following January began to buy the shoes regularly and has used no other since that time. Last June he bought 100 of them. They have lasted from four to five months each. He states that the wooden plugs give more friction with even less pressure on the wheels and stop the car quickly and avoid the usual jerking. The wooden plugs permit the use of a closer grained and somewhat harder metal, which will account for the increased service. This increase may also be due to the less pressure required on the brake.

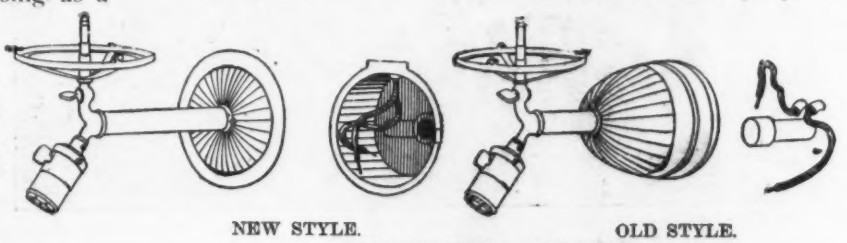
Mr. E. C. Foster, general manager of the Lynn and Boston Street Railway Company, stated that they had used different types of wheels from different makers, all of which had been fairly satisfactory. The wheels they were now using as a standard were 30 inches in diameter, 2¼ inch tread, ¾-inch flange and weighed 350 pounds. When they first commenced to operate by electricity they used 250-pound wheels, and increased the weight up to 300, and finally to 350 as a standard. Most of the wheels that they have in service under the electrical cars have worn until they became flat, which has been due largely to the amount of duty performed by the wheel, although they have had cases where it was caused by the motorman applying the brake too quickly, thus allowing the car to slip on the rail. The shoe that they have adopted as a standard is one of medium hardness. A very hard shoe would give too great wear on the wheel and a too soft one too great wear on the shoe. They had successfully operated their cars equipped with air brakes last summer. He did not doubt that electricity could be applied to braking cars in case of emergency and at very little expense, not exceeding $15 per car. This, however, should be used only as an emergency brake. They had also some experience with the track brake, but had some difficulty with this for the reason that a presure could be created that would raise a car from the rail. Their experience with a sand box has not been very satisfactory, and they have confined themselves for the past season to the ordinary tin pail filled with sand and a fire shovel on the front platform.

Mr. Maurice Hoopes, of the Lynn and Boston Street Railway, said in regard to reverse brakes that he did not see why more use was not made of the motor for this purpose. There is a demand for a method of stopping cars over which control has been lost. Such cars if equipped with two motors and a system of wiring which does not parallel the armatures independent from the fields but parallels the two motors, may be stopped usually by simply throwing the reversing switches, and in the case of the S. P. controller equipment, placing the controller on one of the parallel positions. Unfortunately it often happens that instead of one motor overpowering and reversing the field of the other, the two motors build up exactly together, in which case there is no current, and hence no retardation. In order to make the operation of this method a certainty, it is only necessary to replace the ordinary overhead cut-out switch with single-pole double-throw switches wired to disconnect the motors from trolley and connect to ground. With this arrangement, if a motorman loses control of his car in all other ways he may throw off this switch and reverse the car as though power were on. This makes the control of the car entirely independent of the mechanical brake and of power from the line. It has an additional advantage of stopping a car on a slippery track when nothing else will. This is because of the fact that the braking is automatic to the point of slipping without passing it. The cost of equipping a car is very slight.

Mr. G. E. Cutler, of New York, who was the special guest of the Association, discussed the question of accident insurance. He defined the various kinds of casualty and liability insurance, giving the experience of different companies, and argued in favor of the formation of an accident insurance company by street railway companies, a matter which the Association has had under consideration for some time. It was voted to refer the question to the Executive Committee, with authority to appoint a sub-committee if necessary. A vote of thanks was given Mr. Cutler for his able address.

A Combination Thimble for Gas and Electric Fixtures.

A useful device has recently been introduced on the market by the Miller Electric Construction Company, of Pittsburgh, Pa., to provide for the arrangement of the connections of the gas and electric light fixtures within thimbles or shells embedded within walls or ceilings, thereby permitting of the use of small canopies for covering the mouths of the shells or thimbles.



NEW STYLE. OLD STYLE.

COMBINATION THIMBLE.

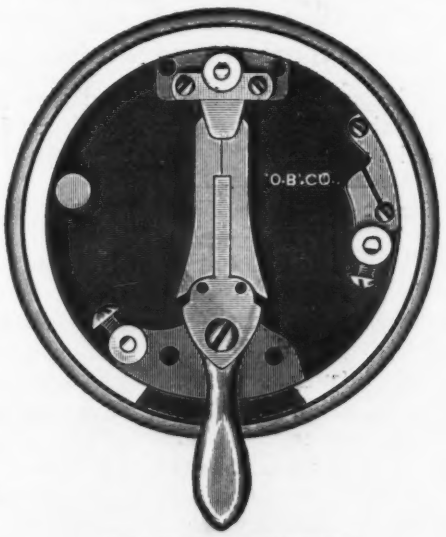
By the old method the gas pipes are usually so arranged in houses that the outlet ends project from two to four inches from the side walls or ceiling, and on account of the size of the insulating joints and fuse-blocks, and the length of the projecting ends of the gas pipe, the canopies used for concealing these parts are, on account of their size, nearly as unsightly as the joints and fuse-blocks themselves. By the new method the thimbles are so arranged in the walls or ceilings that their front edges will be flush, or approximately so, with the outer surface of the plaster. In case no fixture is desired where the thimble is located, a cover can be screwed into the mouth of the thimble and can then be papered over or otherwise concealed. All the connections, such as insulating joints, fuse-blocks, etc., can be arranged within the thimble, which can be closed with a small flat canopy. Thimbles designed for brick walls are provided with reinforced seats for the heads of the screws employed in se-

curing them in position, but the thimbles for frame partitions or ceilings are provided with wings, whereby they may be secured to the studding.

The thimble will also afford protection against fire, as in case of the leakage of gas at the joint and its ignition by the electric current, the flame will be confined within the thimble, which is preferably lined with asbestos, thereby preventing the ignition of any adjacent woodwork. The thimble can be used in connection with gas fixtures alone, in which case the nipples may be omitted, or the thimbles may be secured in walls or ceilings, without connecting with a gas pipe, as a support for electric fixtures, which can be screwed directly to the inwardly projecting nipple.

A Headlight Switch.

The accompanying cut shows a view of a three-point quick break headlight switch, manufactured by The Ohio Brass Company, of Mansfield, Ohio. The use of this switch simplifies car lighting when the electric headlights are used, as one switch only is necessary to control the entire circuit. It is three and one-half inches in diameter and seven-eighths of an inch deep over all. The metal parts are mounted on a slate base which is provided with a metal covering, and the whole switch presents an ornamental appearance, in keeping with the other interior furnishing of the car. The blade of the switch has pivoted side pieces or wings, which are normally held together by a spring fastened to the under side of it. In breaking a circuit a positive motion is given to one of the wings of the blade which leaves the contact piece first by the centre arm which is rigid to the handle. The other wing, however, is held between the contact lips of the binding post until the shoulder on the switch handle strikes against its projected flange. It is then forced out of the lips and the tension which is thus placed on the spring tends to draw it quickly into its normal position. The switch is placed in circuit between



HEADLIGHT SWITCH.

the lights in the body of the car and the headlights, to which independent wires are run from the binding posts of the switch and then grounded. In this way a series of five lamps is always maintained. Either headlight can be controlled independently of the other or the entire circuit cut in or out at will.

A New Direct Current Arc Generator.

The results of extended and elaborate experiments, carried on for a long time by the Westinghouse Electrical and Manufacturing Company, with a view of obtaining a dynamo that would better fulfil the requirements of direct current arc lighting than any heretofore in use, are embodied in its new direct current arc machine, which we illustrate.

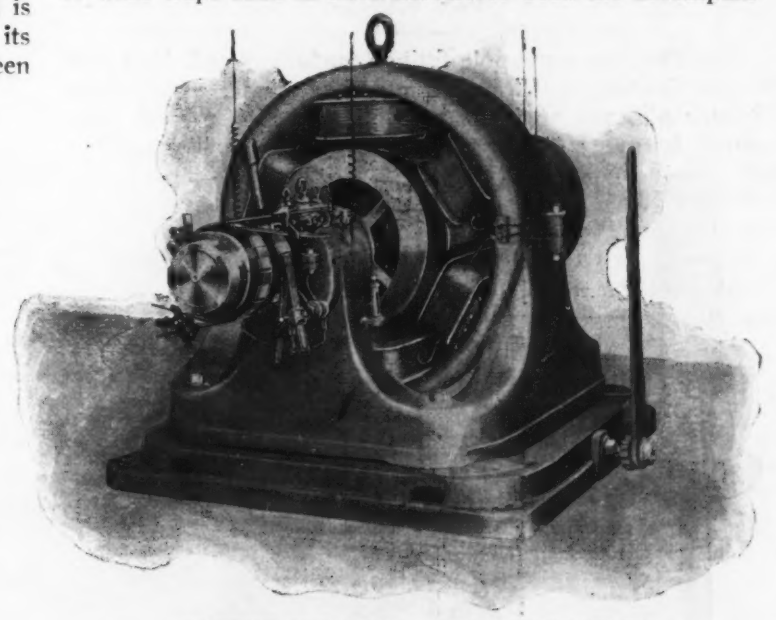
Though the new machine differs very radically in construction from former types, it belongs to the well-known open coil continuous current class, which is acknowledged to offer special advantages for arc lighting work.

A machine of this class delivers a uni-directional though not continuous current, for while the electromotive force of the terminals does not change its sign, it nevertheless pulsates or fluctuates. This pulsating of the electromotive force gives a steady mean value to the current, and makes it particularly adapted for arc lighting, as its pulsating character keeps the mechanism of the lamps in a slight but constant vibration, thereby rendering them less liable to become slow in action or altogether fail to feed.

The new machine in general appearance is similar to the Westinghouse standard alternating current dynamos, that is, it consists of a circular cast iron yoke parted horizontally and having inwardly projecting poles. The armature is of the toothed type with lathe wound coils, especially heavily insulated.

The public are thoroughly familiar with the advantages of the toothed armature, which avoids the use of band wires and allows the replacing of an injured coil with but small outlay of time and money. The use of lathe wound armature coils secures any desired degree of insulation, a most important point in the construction of every arc dynamo. The armature is supported in self-oiling bearings with spherical seat, so that the machines are self-aligning. The bearings are cast solid with the lower half of the field, thereby securing great strength and rigidity of construction.

A particularly strong point claimed for the machine is the system of regulation. It has absolutely no regulating devices or walls traps such as have heretofore been the accompani-



DIRECT CURRENT ARC GENERATOR.

ments of all constant current machines. Regulation is effected, as in the Westinghouse alternating current arc machines, by the reactive effect between the winding of the field and the armature. The generator may be short circuited and run without injury, and is absolutely self-regulating throughout its entire range of load.

With the use of direct currents, the commutator has always been considered the weak point of the system. Consequently particular attention has been paid to the securing of satisfactory results here. This has been accomplished by the use of a new type commutator which presents a large bearing surface for the brushes and which has the segments sepa-

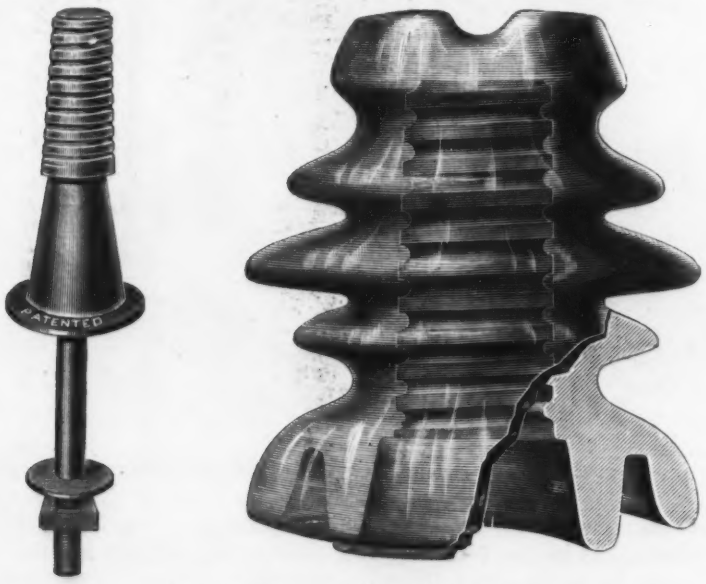
rated by half an inch of insulation, so that the machine is particularly free from vicious sparking. Four sets of copper brushes collect the current without the use of "blow-outs" or other troublesome devices intended to avoid sparking.

The field coils are connected in series with one another. The exciting current is supplied from a separate low voltage machine so that the use of high potentials in the field windings, a menace to insulation and life, is avoided. An efficiency of over 90 per cent. is claimed for the new machines, which far exceeds anything heretofore available, as the best direct current series arc machines are ordinarily very inefficient. The speed varies from 750 revolutions for 60-arc 9 1-2-ampere machines to 950 revolutions for 25-arc machines.

The lamps supplied with the machine are of the rack feed type, affording the excellent method of regulation secured in the Westinghouse constant potential lamps. In the construction of these lamps particular attention has been paid to making them rigid and durable, thus enabling them to give long continued service with a minimum amount of repairs. The lamps are designed to suit the requirements of all kinds of service. The outdoor lamps are plain in appearance, but weatherproof. The indoor lamps are made in a variety of forms with brass or galvanized iron mountings, and with plain or fancy globes. The lamps use a plain or coppered carbon 5-8 inch in diameter, and they will give 14 hours' life with one trimming. These lamps are designed to be used on any direct current series arc system which supplies 9 1-2 amperes. The lamps are supported from strong non-combustible metal hanger boards. Each lamp is supplied with an automatic cut-out, so that when the carbons are burned, or if any accident happens to the lamp, it is automatically cut out of circuit without disturbing the other lamps in use.

Pole Fittings.

We illustrate some pole fittings made by Fred. M. Locke & Co., Victor, N. Y., consisting of an "indestructible" insulator pin, and an insulator, both of which present some novel features. The transposition insulator illustrated is

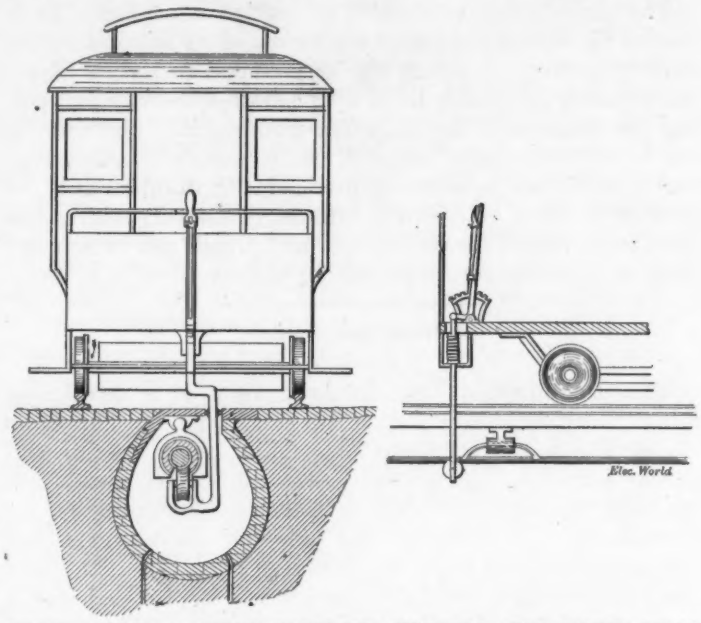


NEW INSULATOR AND PIN.

made of a special quality of transposition glass. The same firm manufactures a triple petticoat insulator, for use where light insulation is needed.

New Conduit System and Insulator.

Dr. Charles H. Bowen, of Washington, D. C., has recently been granted letters patent for a conduit street railway system, illustrated in Figs. 1 and 2, which also show the details of the contact mechanism. The method of insulation shown in Fig. 2 is illustrated in detail in Fig. 3. The in-



FIGS. 1 AND 2.—NEW CONDUIT SYSTEM AND INSULATOR.

sulator consists of a hanger of rubber with a slot underneath and a groove or recesses on its upper interior surface.

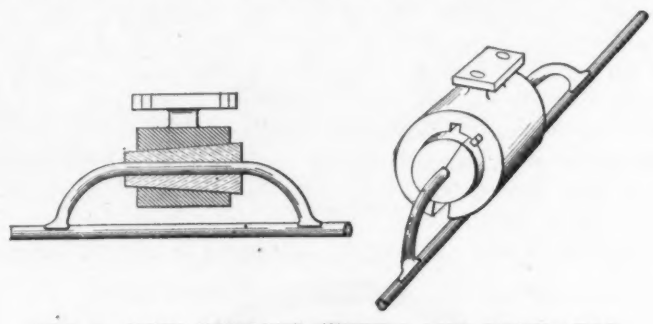


FIG. 3.—NEW CONDUIT SYSTEM AND INSULATOR.

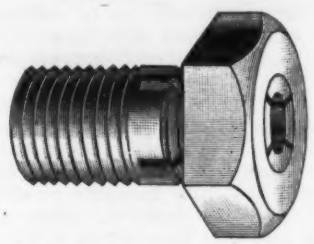
In the hanger is placed a conical divided glass insulating sleeve provided with lugs on its outside surface whereby the sleeve is locked in place by turning the lugs.

Street Railway Bonding Chucks.

There is probably no part of an electric railway system so important as the bonding of the rails, and one to which so little thought heretofore has been given. Engineers frequently make elaborate calculations as to the amount of copper feeder wire required, and as a result of this have submitted reports to their directors and companies, drawing the fine line of economy between interest on the investment of copper on the one side and the increased cost of the coal pile due to the other. These statements and reports are of little value for the reason that they are all based upon the track resistance being of a fixed and certain quantity. The difficulty is not with the science, but the fault lies entirely in the practice.

In electric railways the track is a part of the circuit, and therefore an element of resistance in the track is as serious a matter as it would be if in the feeders of the line; and in any such system of track bonding where there is a possibility of loose contact, this element becomes so uncertain as to not alone make these calculations above referred to of but little value, but frequently result in such a loss of energy and drop of pressure as to cause the burning out of the motors upon the line, and thus run up the cost of maintenance to a prohibitive figure. And where the cause of this drop is not understood, extra copper is installed without benefit.

With the bond we illustrate, manufactured by Stern & Silverman, 707 Arch street, Philadelphia, it is claimed that



STREET RAILWAY BONDING CHUCK.

the contact is always positive between the bonding chuck and the rail and the wire, and the condition such that loose contact is a matter of impossibility. It is true that a slightly additional amount of labor is required to install these bonds, but this is nothing in comparison to the amount of copper feeder that is required to compensate for the losses occasioned by other forms of electrical bonds.

Portable Recording Wattmeter for Street Car Testing.

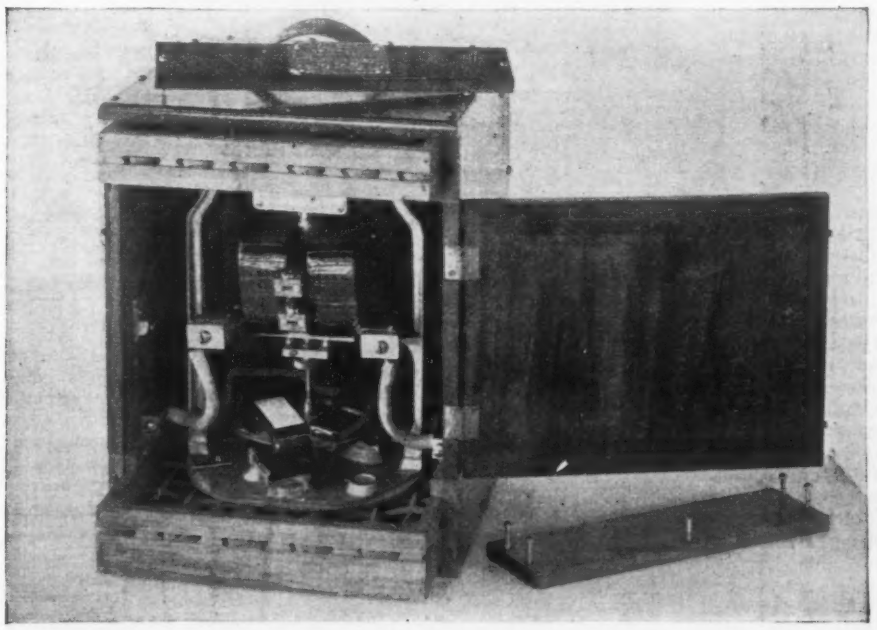
It is frequently necessary in electric street railway practice to test the power consumption of the cars, and heretofore the General Electric Company has furnished a 500-volt meter mounted rigidly within a mahogany box for this purpose. This was, however, found not to be without faults. The mechanism being rigidly mounted, the meter was subjected to violent jars which frequently interfered with its accuracy, shortened its life and rendered it unsatisfactory. Experiments have been going on for some time past to evolve a satisfactory portable recording meter for the purpose named, and the General Electric Company now announces one which will satisfy the many requirements of street railway service.

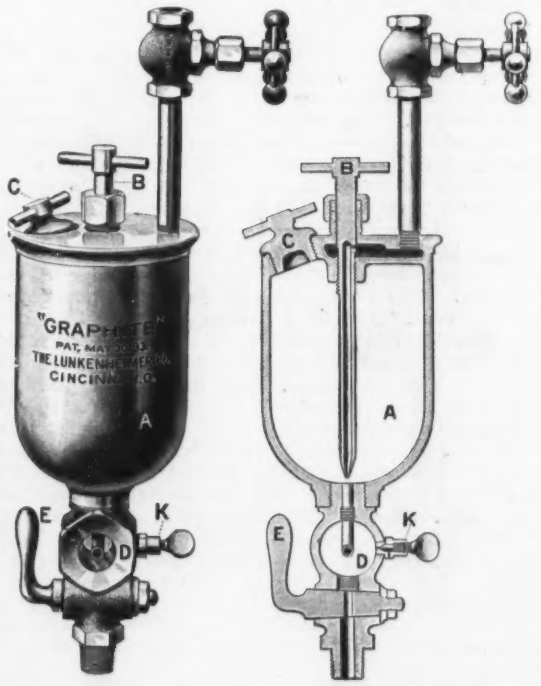
The meter in question consists of a Thomson recording meter mounted on a skeleton metal frame and having a capacity of 25 amperes at 500 volts. It is mounted within a polished wood carrying case about two-thirds the size of the former type. Instead of being rigidly mounted in the case the meter is suspended between two networks of interlaced rubber cord, or, as it were, between two rubber hammocks. This method of suspension saves the meter from violent agitation or shocks, and renders its accuracy reliable. It is the first time that this system has been applied to the recording meter, and it is a feature which will recommend it to all street railway men. The meter may be used placed upon the floor of the car with absolute safety and convenience, and gives perfectly accurate readings.

This portable meter is normally rated at 25 amperes. In testing street cars, however, the current will frequently, for short intervals, very greatly exceed this, as when starting or upon heavy grades, but this meter is so constructed as to record these sudden bursts of current accurately; and enormous overloads may be carried through the meter for short intervals without detriment to the instrument or impairment of its accuracy.

Graphite Sight Feed Lubricator.

It is well known by engineers generally that pure flake graphite is far superior to oil or any other lubricant, when properly applied to steam engine cylinders, but being a dry powder and not mixing well with oil, the difficulty has been to properly supply it to steam chests and cylinders of engines and pumps. A lubricator, which we illustrate, that not only feeds the graphite automatically and continuously in desired quantities, but also does it visibly, by passing through a sight feed, has recently been placed on the market by the Lunkenheimer Company, Cincinnati, Ohio. The cup should be attached like any ordinary sight-feed oil lubricator to the steam pipe above the throttle, but can also be attached below the throttle or on the steam chest, with the upper steam connection above the throttle. Referring to the cup, *A*, is the graphite reservoir, *B* the graphite regulating valve, *C* the filling plug, *D* the bullseye sight feed chamber, *E* the feed regulating valve, and *K* the drain valve. The lubricator is operated as follows: Close the globe or steam valve and stop cock *E* and then take off the filling plug *C*, and fill the reservoir with graphite. After replacing the filling plug, first open the globe or steam valve, then open the stop cock *E*, then regulate the flow of graphite by valve B; next regulate the stop cock *E* carefully, and leave it so regulated that the desired flow of graphite is fed visibly out of the nozzle *D* in the sight-feed chamber. As graphite is a very superior lubricant, and a very small quantity will last a great while, it should be used very economically, as a continuous feeding is not necessary, the feed being occasionally shut off.





PORTABLE RECORDING WATTMETER.

Financial Intelligence.

The Electrical Stock Market.

New York, March 17, 1894.

GENERAL ELECTRIC, after being very strong during the first part of the week, was made the target of bear attacks in later days, and lost a portion of its gain. In these raids upon the stock's quotations, the bears were helped along by realization sales on the part of the bull pool that engineered the rise from 32 to 44, and were anxious to rake in some of their 12-point paper profits. The decline of the last few days has naturally been accompanied by a flood of bear stories. A director is quoted as saying that the General Electric Company is at the present time doing a business of but between $600,000 and $700,000 per month, or about $8,000,000 a year. He adds: "We hope to pay some dividends by and by, when the capital account is adjusted. The deficit to be shown in the annual report will be large enough to satisfy anybody." Again, it is stated that the accounts of the Northwest branch are in bad shape, and that orders are again falling off at such a rate that, as soon as the present contracts for motors are filled there will be another reduction in forces at the Lynn works. Boston and New York holders have, moreover, been somewhat disappointed—and have manifested their feelings by selling stock—at the failure of the management to give out the long predicted statement, showing that the company had no floating debt, which was promised by March 1. The dividend question is still a matter of the greatest uncertainty. It has not yet been decided whether or not to pay the deferred dividend on the preferred in April, as some directors now are in favor of waiting for the regular June period of distribution, when they will declare the whole payment of 7 per cent. On the other hand, the friends of the property are as enthusiastic as ever in their behalf in the company's future. Especially great things are presaged from the General Electric Company's connection with the Cataract Electric Company, which has harnessed Niagara Falls for the generation of electricity, and which has just secured a contract which gives the use of State canal lands for the distribution of electrical power all over the State. The Cataract company has secured most advantageous terms in its agreement with the State. Among the capitalists most largely interested in the Cataract Electric Company are J. Pierpont Morgan, William K. Vanderbilt, H. McKay Twombly and other leaders in the General Electric Company, and it is but natural to assume that the operations of the Cataract company will result in the placing of large orders for equipment and supplies with the General Electric Company. No mention has recently been made by insiders regarding earnings, and the report to be handed in at the next month's annual meeting is awaited with a deal of interest.

WESTERN UNION TELEGRAPH stock monopolized Wall Street attention at times in the earlier part of the week. The stock has gone off a couple of points on the publication of the adverse quarterly report presented at the directors' meeting on Wednesday. The directors declared the regular quarterly dividend of 1¼ per cent., but the statement shows that this amount was not earned in the quarter ending March 31 next. The net earnings for that period are estimated at $1,050,000 as against $1,584,434 last year and $1,549,637 two years ago. As there are $94,820,000 stock outstanding, only 85-100 of 1 per cent. was earned on the stock, and, in order to pay the full dividend of 1¼ per cent., the directors will have to draw upon their surplus to the extent of $378,737. The comparison of net earnings shows a shrinkage of 33 per cent. in spite of extensive economies in the operating department. Not content with this, the bears lay stress on the fact that the directors are borrowing money to pay dividends, when the physical condition of the property is far from good. There really is no harm done to the company, as the Western Union is financially strong enough to do this for some time, but it creates a very bad impression. Insiders hasten to assure stockholders that things are not really so bad as would appear from the report just published. The loss in net revenue is fully explained, they say, by the reduced volume of business, and would have been greater, had not operating expenses been reduced 16 per cent. Moreover, the March quarter is the worst one in the year, and a deficit of $378,800 in that quarter, according to insiders, is practically certain to be made good by the surplus of some succeeding quarters. For instance, there was a surplus in the December quarter of $308,094, and, if the two quarters are taken together, there is only a deficit of $70,643 to be made up, against which the Western Union has an accrued surplus of nearly $7,000,000.

AMERICAN BELL TELEPHONE has been very strong in Boston, advancing chiefly on the covering by shorts, who have been scared by the increasing indications that the company will get desired legislation in the matter of the proposed increased capitalization. The opposition to the new stock issue has been almost entirely withdrawn, and there is no question but that the petition of the company will be speedily granted. None the less lower prices for the stock may still be counted on. True, the regular quarterly dividend of 3 per cent., payable April 16, has been declared, as expected by stockholders, but the anticipation that the rate is likely to be cut before the year is ended is gaining ground in view of threatened competition. With an issue of new stock coming (which may or may not be sold by auction), and the consequent increase in dividend requirements, a considerable decline in the price of the stock would seem to be an almost assured certainty.

THE EDISON ELECTRIC ILLUMINATING COMPANY of Brooklyn advanced this week its quarterly dividend rate from 1¼ to 1½ per cent., making the annual rate 6 instead of 5 per cent.; in consequence the stock has advanced several points. The company's officials state that the business is spreading at a most gratifying rate, and the increased dividends are ample evidence that it is making money. The contract for lighting Brooklyn streets is likely to be given, for the greater part, to the Edison company.

THE EDISON ELECTRIC ILLUMINATING COMPANY'S stock of Philadelphia has shown considerable strength recently. The stock, which was quoted two weeks ago at around 120, is now sold at 132, and it is reported a few shares have gone as high as 140. This security is an 8-per cent. dividend stock, and is considered one of the most valuable of Edison Illuminating properties.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY will receive tenders for the sale to it of $500,000 of the first series of 6 per cent. bonds, due April 1, 1899; in no case will the company pay more than $1,020 and accrued interest for any $1,000 bond. The New England Telephone Company is now offering to lease magneto telephones for use on private lines for $1 per annum for each instrument. It is also offering to lease the magneto call bell for $3 per annum. This bell is an essential part of the telephone, unless some other form of signal, such as an electric call bell or tapper can be employed, without adversely affecting the use of the telephone.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES' trustees have expended $200,000 additional in the purchase of preferred stock at an average price of 84.9 per share.

ELECTRIC TRACTION COMPANY STOCK has again been pressed for sale in Philadelphia on account of the inability or unwillingness of holders to pay the remaining installments. This week $10 per share was payable, and an additional $15 per share is due April 16, when the stock will be full paid.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	35
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	97	97½
" " " 1sts	—	103	104
Edison Electric Ill., Brooklyn	100	102	105
" " " Boston	100	112	115
" " " Chicago	100	125	130
" " " Philadelphia	100	130	132
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	10	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	41⅞	42
" " " deb. 5's	—	84½	85
Interior Conduit and Ins. Co	100	20	30
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	32	33
" " " pref.	50	49	50
Western Union Telegraph	—	85¾	85⅞
American Bell Telephone	—	181	182

New Incorporations.

EAU CLAIRE, WIS.—The Brooklyn Electric Light Company has been incorporated here. Fitch Gilbert is president, R. E. Rust is vice president and George T. Thompson is secretary-treasurer.

THE LOUIS K. COMSTOCK COMPANY, Chicago, Ill., capital stock $20,000, has been formed to engage in the business of general electrical engineering and construction, etc. L. K. Comstock, F. S. Richmond and P. V. Cary are the promoters.

THE LYNN MANUFACTURING COMPANY, Portland, Me., capital stock, $10,000, has been formed to manufacture and deal in all kinds of electrical supplies. A. T. Hallbauer, Lynn; J. C. Barr and R. H. Weld, Jr., Boston, Mass., are the promoters.

THE BROOKVILLE ELECTRIC LIGHT COMPANY, Eau Claire, Wis., capital stock $15,000, has been formed to an electric lighting business. R. E. Rust, G. T. Thompson and F. Gilbert are the promoters.

THE VALPARAISO MANUFACTURING COMPANY, Valparaiso, Ind., capital stock, $10,000, has been formed to manufacture electrical instruments, etc. The incorporators are J. W. Elam, F. S. Wenk, G. Crumppacker, C. B. Woodard and J. W. DuLaney.

THE CLEARFIELD AND CONEMAUGH RAILROAD COMPANY, Clearfield, Pa., capital stock $1,350,000, has been formed to construct and operate an electric railway in Clearfield and Cambria counties. J. Morgan Cooper, G. D. Prentice and C. H. Sackrider are the interested parties.

THE CENTRAL ELECTRIC ELEVATED STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock, $200,000, has been

formed to construct and operate an elevated electric railway in Philadelphia and to Bustleton, a distance of 333 miles. William J. Hamilton, J. Blair and J. Armitage are the promoters.

THE MADISON LIGHT AND POWER COMPANY, Chicago, Ill., capital stock $10,000, has been formed to do wiring for arc and incandescent lamps, manufacture electrical apparatus, furnish electrical and steam power, etc., etc. The promoters of this concern are G. H. Shippy, E. P. Ames and F. J. Baker.

THE TOLEDO, MAUMEE AND PERRYSBURG ELECTRIC STREET RAILWAY COMPANY, Toledo, Ohio, capital stock $150,000, has been formed to build or acquire and operate electric street railway. The organizers are J. K. Tillotson, F. M. Ohl, L. G. Richardson, D. Atwood and N. McCarty are the incorporators.

THE TOPEKA-HARRISON TELEPHONE AND ELECTRICAL COMPANY, Topeka, Kan., capital stock $25,000, has been formed to build and operate telephone lines and to deal in electrical machinery. S. J. Bear, A. K. Rodgers, W. H. Rossington, James Smith, J. G. Waters, Topeka, Kan., and H. S. Buck, Stewardsville, Mo., are the incorporators.

CHESTERTOWN, MD.—A bill has been introduced at Annapolis by Senator Hepbron to incorporate the Chestertown Light, Heat and Power Company. capital stock $500,000, to furnish light and electric communication between Chestertown and Chesapeake Bay. George H. Sharp, John D. Urie, John K. Aldridge, Charles T. Wescott, and William D. Burchinal are interested.

ALBANY, N. Y.—The Cataract General Electric Company has been chartered to supply electricity with which to operate boats. Thomas C. Platt, of the United States Express Company, New York; Charlton T. Lewis, counsel to the Mutual Life Insurance Company, of New York, and William Martens, of L. Von Hoffmann & Co., New York, are interested. Frank W. Hawley, of Pittsford Farms, near Rochester, N. Y., is vice president.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row NEW YORK, March 1 , 1894.

THE STOREY MOTOR AND TOOL COMPANY, through a typographical error, advertised in our last issue as being located at No. 20, instead of 120, Liberty street.

BROOKLYN, N. Y.—Sealed proposals will be received at the office of the superintendent of the Brooklyn Bridge, 179 Washington street, Brooklyn, to April 5 for plans, specifications and estimates for lighting the bridge cars by electricity; also for heating and propelling them. C. C. Martin is chief engineer.

THE OKONITE COMPANY, LTD., 13 Park Row, is presenting to its friends and patrons a handsome piece of desk furniture, consisting of a glass paperweight, with a small clock in the interior. The combination is very neat, and the timepiece keeps very good time—neither of which is true of most articles of this kind.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., March 17, 1894.

THE PROJECT to place electric wires underground is causing much agitation in Boston and vicinity, hearings being held by legislative and aldermanic committees almost daily.

THE BURYING of overhead wires is still being considered by State and city legislative committees, but any immediately definite legislation is regarded as doubtful by those who ought to be in a position to judge.

THE TRANSIT COMMITTEE of the Massachusetts State Legislature is still busy upon hearings relative to a subway in Boston. General Francis A. Walker, president of the Institute of Technology, recently testified that he regarded elevated roads as the least satisfactory of all modes of solving the question of rapid transit. The subway would, he thought, prove at least a temporary solution, and would perhaps prove the foundation of a more extensive system. Whenever it was necessary to relieve the restrictions it would pay for itself. On general principles he was opposed to the referendum, but if there were any peculiar or exceptional circumstances in connection with their proposition he would not be averse to submitting it to the people for their approval or rejection.

ON LAST SATURDAY EVENING, in response to an invitation from Mr. C. W. Holtzer, 24 gentlemen, nearly all of whom were members of the old Boston Electric Club, assembled at dinner at Young's Hotel, Boston. The idea was to obtain expressions as to the advisability of organizing another electric club in Boston, and the feeling was unanimously in favor of it. It was thought that with the experience of other clubs as a guide, a club might be formed which could be made both instructive and profitable. The occasion was a very enjoyable one, indeed, and Mr. Holtzer was the recipient of universal congratulations. Mr. W. J. Denver, assistant manager of rthe New England Telephone Company, and a past president of the Boston Electric Club, officiated as toastmaster in his usual happy manner. Remarks favoring the organization of a club were made by Messrs. Ridlaw, Hewins, Orford, Farnham, Lang, Tuckerman, Caldwell, Adams Ross, Hathaway and Key, and before final adjournment it was voted that Mr. Denver, Colonel Hewins, Mr. Ridlaw, Mr. Holtzer and Mr. Ross act as a committee on further organization. Those present were: C. W. Holtzer, W. J. Denver, Colonel E. H. Hewins, J. M. Orford, W. S. Hill, I. H. Farnham, E. J. Boynton, S. G. Stiness, G. L. Lang, G. W. Adams, F. M. Kimball, E. L. Caldwell, F. S. Palmer, C. W. Gates, R. F. Ross, F. E. Donahoe, W. A. Hathaway, C. R. Remington, S. W. Leedon, E. S. Pillsbury, W. S. Key, H. G. Tuckerman, W. E. Holmes, Frank Ridlaw and W. D. Warner.

Pittsburgh Notes.

PITTSBURGH, March 17, 1894

THE McKEESPORT AND WILMERDING ELECTRIC RAILROAD has ordered a new 40-foot freight car to be equipped with two 40-h. p. Westinghouse motors. This is made necessary by the great increase in freight traffic the company has experienced on its line.

THE ALLEGHENY COUNTY LIGHT COMPANY of this city, at a meeting of the board of directors yesterday afternoon, declared a dividend of 1½ per cent. This is the first dividend the company has declared since 1890, and it is expected that it will be continued permanently.

A FEW DAYS AGO ground was broken for the erection of an electric fountain, which the Pittsburgh Traction Company will donate to the city. The fountain is to be constructed in Schenley Park, and the electric plant to be used in connection with the fountain will also furnish current for the lighting of the park.

J. H. CARR, a young man of McKeesport, and a former employe of the Westinghouse Electric and Manufacturing Company, has invented an electric bicycle which is pronounced by experts to be a remarkable and ingenious production. The battery of the machine is placed beneath the saddle. The bicycle has no pedals, but simply two bars for foot-rests. It is said that the machine can be run at a wonderful speed.

English Notes.

(From our own Correspondent.)

LONDON, March 7, 1894.

THE TESTING OF HOUSE INSTALLATIONS.—The City of London Electric Lighting Company has sent a circular to its clients, offering, for an annual fee of 10 shillings, to send around competent inspectors at regular intervals to test the insulation of their house wires, and to report generally upon the condition of their fittings. This idea should prove at once remunerative to the company, and useful to the consumers.

ELECTRIC RAILWAYS.—The tunnel electric railway, which it is proposed to run from the terminus of the London and South Western Railway, which is on the south side of the Thames, into the city, bids fair to be the first completed of the many underground electric railways for which Parliamentary powers have been obtained for some little time. At the recent annual meeting of the London and South Western Railway Company it was agreed to guarantee the company about to construct the electric railway a dividend of 3 per cent., all profits above the sum necessary to pay this dividend being divided between the shareholders of the London and South Western Company and the Electric Railway Company. An interesting paper was read by Mr. Greathead and Mr. T. Parker before the Institution of Civil Engineers last evening on the Liverpool overhead railway. It was stated that the average actual coal consumption on the Liverpool overhead railway was about 16 pounds per train mile for trains of about 38 tons weight, sitting 114 persons and running at an average speed of 12 miles an hour; the coal being bituminous slack. Mr. Greathead was very enthusiastic about the excellent qualities of the electric motor for traction purposes. He showed that the weight of the electric motors on the Liverpool line was only 20 per cent. of the weight of the full train, whilst the weight of the steam locomotives on most of our London suburban lines was 40 per cent. of a fully loaded train. He also showed that on the Liverpool line, the adhesion taken is one-seventh of the weight on the driving wheels, amounted to 115 pounds per train, whilst on the underground the figure was only 61, and similarly the tractive effort at starting in pounds per ton of train was in the case of Liverpool 120 pounds and in the case of the underground only 71. There were several of our best known railway

managers and engineers present at the meeting, and considerable astonishment was expressed by them at these figures, and at the remarkable high general efficiency of the line.

News of the Week.

Telegraph and Telephone.

ARKADELPHIA, ARK.—The City Council has granted a franchise for the construction of a telephone line.

BLACK ROCK, NEAR BUFFALO, N. Y.—Thomas Fitton, of 978 West avenue, is at the head of a movement among the members of the Black Rock Business Men's Association to organize a telephone company.

WASHINGTON, PA.—The Washington Telephone Company, represented by John D. Braden, and the American Telegraph and Telephone Company are asking for a franchise for constructing their respective lines, and the matter will come up at the next meeting of the Council.

Electric Light and Power.

ELKHORN, WIS., residents are asking for electric street lighting.

WINNETKA, ILL.—Electric lighting is being talked of for Winnetka.

COCHRAN, GA.—W. H. Mobley is in the market for electrical machinery.

STURGIS, MICH.—Sturgis residents will vote on issue of $20,000 electric light bonds.

WEST JEFFERSON, OHIO.—The matter of putting in an electric light plant is being considered.

SELMA, ALA.—The Gas and Electric Light Company has added another 50-light arc dynamo to its plant.

NEW BRIGHTON, S. I.—The contract for lighting New Brighton will be advertised for sale April 1.

BLUE EARTH CITY, MINN.—A franchise has been granted to O. J. Clarke to put in an electric light plant.

EASTON, PA.—The Common Council will issue $12,300 in bonds, of which $3,000 is for an extra dynamo and belting.

OTTUMWA, IOWA.—The Coughlan Electric Company is seeking for a franchise to erect an electric light plant.

OMAHA, NEB.—The Pardee Company is seeking a 30-year franchise for the operation of an electric light plant.

ADRIAN, MINN.—The town has voted $13,000 to be expended in putting in a waterworks and electric light plant.

BLISSFIELD, MICH.—The village will soon vote in the matter of granting an electric lighting franchise to a private company.

THOMASVILLE, GA., will now have incandescent lights, as the electric light company has added a 1,000-light alternator to its plant.

OSHKOSH, WIS.—Bids will be received to March 20 for the lighting of the city by electricity. W. T. Ellsworth should be addressed.

BALTIMORE, MD.—A bill has been introduced into the House at Annapolis to authorize Baltimore to purchase and operate an electric light plant.

MENOMINEE FALLS, WIS.—C. W. Fraser, city clerk, has been instructed to ascertain the approximate cost of putting in an electric light system.

MINNEAPOLIS, MINN.—The Cooper-Compton Electric Company will extend its operations. John Martin is president and A. W. Hastings is secretary.

MINNEAPOLIS, MINN.—F. W. Cappellen, city engineer, reports to Council the cost of a municipal plant, and plans and specifications have been prepared.

QUITMAN, GA., has recently closed a contract for a municipal electric plant. The apparatus to be installed consists of a 50-light arc dynamo and a 500-light alternator.

GRIFFIN, GA., has purchased the arc light plant in use for lighting the streets, and has added a 1,000-light alternator. The plant will be operated as a municipal plant.

TOLEDO, OHIO.—The Memorial Hall trustees have instructed the committee to look into the matter of electric lighting for the building, and report at the next meeting.

ROCKVILLE, CONN.—The directors of the Gas and Electric Company have voted to put in a steam engine in place of the gas engines, to furnish power for the electric light station.

FLATBUSH, LONG ISLAND, N. Y.—James Deighan has received the contract to build an electric light plant for Flatbush and Parkville, and he will be ready to supply light about May 1.

CINCINNATI, OHIO.—The Gerdes Hotel property, at Fifth and Home streets, is to be remodeled at a cost of $21,000, to include elevators and electric lights. Dittee & Wisenall are the architects.

ATHENS, GA.—The committee on light has reported in favor of either purchasing the plant of the Athens Gas Light Company or buying a new plant, to cost about $15,000. T. P. Vincent is chairman.

MEADVILLE, PA.—There is a deadlock in the Meadville Council in the matter of appointing a committee to investigate the electric light plant. It is admitted that its condition should be improved.

LILLY, PA.—Craig & Bowers are solicitors on behalf of Edward O'Brien, George Brandt, M. K. Piper, John R. Kelly and John Leap, who wish to form the Lilly Electric Light, Heat and Power Company.

DETROIT, MICH.—Plans and specifications are being made by Donaldson & Meier for the erection of a business building for the Palms estate, for Edson, Moore & Co. The building is to be lighted by its own electric plant.

POTTSVILLE, PA.—Sealed proposals will be received by the comptroller of Schuylkill County to 2 P. M., March 20, for lighting the court house and city prison by electricity or gas during the year commencing April 1. B. R. Severn is comptroller.

NORTH TONAWANDA, N. Y.—A committee, consisting of Trustees Fuller, Gillespie and Pitts, has been appointed to draft a bill for presentation to the Legislature, granting the village power to buy and operate at any time an electric lighting plant.

BUFFALO, N. Y.—The report in favor of a municipal electric light plant was voted upon, and it was decided to postpone indefinitely any action. Alderman Smither was father of the movement for a municipal plant, and he will soon again bring the matter up.

ST. JOSEPH, MO.—The St. Joseph Traction and Lighting Company has been granted a franchise for operating a steam plant. Mr. W. T. Van Brunt, superintendent, together with four councilmen, inspected the plant at Springfield, Ill., recently, and reported most favorably. They have already secured contracts for heating a number of the city buildings and also several large hotels and business blocks. This plant runs 24 hours a day and has about 1,800 h. p.; they intend utilizing their exhaust steam for this purpose.

KEARNY, NEAR NEWARK, N. J.—The Citizens' Improvement Association, of which G. B. Reid is president and H. C. Greene and I. F. Bloodgood are prominent members, are agitating for a municipal electric lighting plant at an estimated cost of $20,650. The present electric light contract expires on the 1st of April, and it proposed to endeavor to obtain a two-thirds majority in favor of the municipal plant. It was decided to wait until the Legislature passes upon the pending bill to allow the construction of such plants.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of the Board of Administration to April 4, for one complete electric lighting plant, to be erected and ready for service at Eden Park pumping station, to consist of a 10 arc dynamo and a 100 incandescent lamp dynamo, with suitable engines. Bidders are to furnish all specifications and state proposed make of dynamo and engine, the plant to be completed ready for steam connection, which will be furnished by the Cincinnati water department. A. P. Butterfield is clerk.

THE WICOMICO FALLS MILLING AND ELECTRIC COMPANY, Salisbury, Md., R. M. and W. T. Johnson, proprietors, has purchased the pole line, franchise, etc., of the electric light plant which was recently burnt out at that place, and which was formerly operated by steam. They have also purchased the water power privileges, which are said to be second only to those on the Brandywine River, and have installed three Victor turbines, and constructed and thoroughly equipped a new station building. They have now running four Edison dynamos in tandem with good success, the total capacity being 2,500 lights.

The Electric Railway.

TOWANDA, PA.—The prospect is favorable for an electric railway from Towanda through Troy to Mansfield.

HANNIBAL, MO.—Charles T. Hayward, Dr. D. H. Shields and others are promoters of the proposed road between Hannibal and Philadelphia.

TORONTO, ONT., CANADA.—R. Meek is before the City Council on behalf of Mr. T. Yarker and others, to build an electric road on the island.

PARKERSBURG, W. VA.—City Council has granted right of way for the proposed electric line. D. B. Judd, of New Haven, Conn., is interested.

NEW ORLEANS, LA., is having trouble with electrolysis of water mains along the line of the St. Charles Avenue and Carrollton Electric Railway.

READING, PA.—The chartering of the Reading and Womelsdorf Railway Company means the building of a 42-mile trolley road between those two points.

LOS ANGELES, CAL.—The county supervisors will receive bids on March 28 for a 50-year franchise for a street railway company. T. H. Ward is county clerk.

POTTSTOWN, PA.—H. E. Crilly, of Allentown, Pa., has been awarded a contract for the building and wiring of the Ringing Rocks Electric Railway, to be completed by May 1.

OAKLAND, CAL.—Ira Bishop, receiver of the Consolidated Piedmont Cable Company, has been authorized to borrow $16,000 to defray cost of changing the motive power to electricity.

BANGOR, ME.—Conrad Miller, president of the Bangor and Portland Railroad, states that the officials are considering the extension of the lines from Nazareth to Catasauqua, via Bath.

WEST HARTFORD, CONN.—The selectmen of West Hartford have voted to accept the plans offered by the Hartford and West Hartford Horse Railroad Company for a trolley line to their town.

BALTIMORE, MD.—The Baltimore City Passenger Railway asks for leave to extend its lines to Lauraville. It proposes to build an electric line, if the Turnpike company does not prevent it.

HOLYOKE, MASS.—The Board of Aldermen have granted a franchise to the People's Electric Railway Company to cover 9⅔ miles of streets, and the road to be located exclusively in Holyoke.

HARRISBURG, PA.—The Clearfield and Conemaugh Railroad Company, capital stock $135,000, has been chartered to build a railroad from Belsena, in Clearfield County, to Johnstown, a distance of 60 miles. S. M. J. McCarrell, of Harrisburg, is president.

NEWBURGH, N. Y.—Captain James M. Dickey and others interested in the proposed electric street railway are now getting consents of property owners along Water and Golden streets and Broadway.

ELIZABETH, N. J.—An ordinance has passed granting the New Jersey Consolidated Traction Company the right to operate a system of trolley cars through the streets of Elizabeth, the lines to be in operation by July 4.

DANSVILLE, N. Y.—The building of the new electric street railway to the Lackawanna station is again a topic of conversation. Dr. James H. Jackson, Superintendent Holstead and Messrs. Blake & Beebe, contractors, are interested.

JACKSONVILLE, FLA.—The street railway company is preparing to adopt electric cars on its lines. It has closed a contract for track material, and expects to contract for electric apparatus within the next 60 days. Ten car equipments will be needed.

LOCKPORT, N. Y.—The Lockport "Journal" states that there is a well defined opinion that W. C. Reed, a prominent electric railway contractor, has secured right of way for an electric road between Lockport and Williamsville and branches of same.

BRIGANTINE, N. J.—The contract for the rebuilding of the railway of the Brigantine Transit Company, at Brigantine, N. J., opposite Atlantic City, has been awarded to Stern & Silverman, of Philadelphia, and it is to be constructed of trestle all along the beach.

SAVANNAH, GA.—The street railways of this city have all been consolidated. The Electric Railway Company, of Savannah which some time ago bought up the Savannah Street Railway, has now scooped in the City and Suburban and all its lines. The consolidated lines are under the management of the Electric Railway Company, with Mr. J. S. Collins as president.

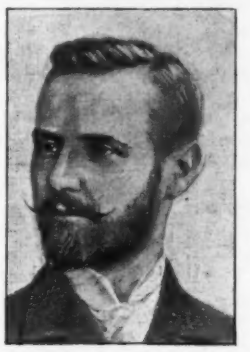
Miscellaneous Notes.

THE COTTON STATES EXPOSITION, to be held in Atlanta, Ga., in 1895, is already an assured success. In three days the people of Atlanta raised $159,360 of the total $200,000 they propose to give. The exposition is to be held at Piedmont Park. Mr. Fred. Law Olmstead has been telegraphed for to lay out the grounds. Director-General H. E. W. Palmer says he intends having the electrical exhibits a special feature of the exposition, which is to open Sept. 1, 1895, and to run three months.

STATISTICS OF STREET LIGHTING BY ELECTRICITY.—The National Statistical Association of Washington, D. C., under the management of Mr. Allen R. Foote, has undertaken a work of great importance to central station officials, in collecting, for the benefit of companies about to make new contracts for street lighting, data relative to the prices paid for street lighting throughout the country, and the service rendered for the compensation paid. The collection of these data will be of great value to all interested in the question. The plan of the Statistical Association is well devised, and its consummation rests entirely with the companies; if they co-operate with the association, and furnish promptly and accurately the information asked for, valuable results will undoubtedly be secured, and it seems that the desired object cannot be obtained in any other way.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its 85th meeting at headquarters, 12 West 31st street, New York City, on Wednesday, March 21, at 8 P. M. A paper will be presented by Prof. William A. Anthony, of Vineland, N. J., past president, "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp." The discussion will be opened by W. Lispenard Robb, of Hartford, Conn. For the convenience of Western members, and in accordance with recent action taken by the Institute, a meeting of members residing in Chicago and vicinity will be held on the same date and hour at the Armour Institute, corner of 33d street and Armour avenue, Chicago. Prof. D. C. Jackson, of Madison, Wis., has been invited to present the paper of Prof. Anthony at Chicago, and Prof. B. F. Thomas, of Columbus, Ohio, to open the discussion.

Personal Notes.



MR. O. T. CROSBY will, on May 1, sever his connection with the General Electric Company, and in connection with Mr. J. G. White, of the New York firm of constructing engineers, will do business under the name of the White-Crosby Company. The company has been incorporated for the sake of convenience, but the association will be that of partnership. Mr. Crosby presented his resignation several months ago, but found it difficult to leave the post he occupied. Mr. Crosby is eminently fitted for the line of work he is taking up, and the new firm will undoubtedly meet with the success that the recognized abilities of its members merit. Mr. Crosby has had a wide experience in the electric railway field. He was born in Louisiana, and passed most of his boyhood in Brookhaven, Miss., from which place he entered the United States Military Academy in 1878, graduating four years later second in rank in a large class. On receiving his commission as an officer in the engineering corps, he was stationed at Willets Point, N. Y., and after two years there was sent to New Orleans for river and harbor duty. In May, 1887, he obtained a six months' leave of absence and soon after resigned and joined the Sprague Railway and Motor Company, soon assuming the duties of superintendent of that company. He retained this position for about 2½ years, and then connected himself with the Weems Electric Railway Company and performed the well known experiments in high-speed railroading at Laurel, Md., which gave us so much information on atmospheric resistance, and which placed him prominently before the public. Mr. Crosby then joined the staff of the Thomson-Houston Company, and after the consolidation remained with the General company, assuming charge of the railway department, where he has taken a prominent part in the development of the street railway business of the company.

Trade and Industrial Notes

GEORGE CUTTER says that his new swivel pole pulley is "just the thing," and he can show nice orders to back his statement.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn., has appointed S. N. Blake, of Elmira, N. Y., contractor for the Mather apparatus in northern and western New York State.

ELLIS D. LASH AND LYMAN HANES, of Martin's Ferry, Ohio, have completed a system of open circuit fire alarm attachments to the regular Gamewell system to operate a bell in each fireman's house.

MR. ROGERS, of the Eddy Manufacturing Company, paid a recent visit to Atlanta, Ga., on business with the Atlanta Traction Company. This company has changed its two 50-h. p. Eddy generators for two 150-h. p. Eddy dynamos.

THE R. THOMAS & SONS COMPANY'S office is now amalgamated, its warehouse being at 142 Lake street, Chicago, where Mr. J. E. Way will be permanently located, and all communications and orders sent to above address will have prompt attention.

PEPPER & REGISTER, Provident Building, Philadelphia, Pa., write us that they have secured the contract for bonding the lines of the Electric Traction Company, and that the bond adopted will be that manufactured by the Technic Electrical Works.

FRED. M. LOCKE & CO., Victor, N. Y., are meeting with much success with their indestructible insulator pin, triple petticoat insulators and transposition insulator. Among other large users is the Westinghouse Electric and Manufacturing Company, Pittsburg.

THE W. T. C. MACALLEN COMPANY, 416 Atlantic avenue,

Boston, has issued its 1894 catalogue of solid sheet mica insulating material, for electric railway work and other purposes. Numerous trolley overhead devices are illustrated, and several forms of gas insulating joints.

Mr. E. O. WAYMIRE, secretary and treasurer of the Dayton Fan and Motor Company, is spending some days in Chicago making arrangements for the handling of his company's electric fan motor outfits. This company is placing on the market a new and exceedingly handsome ceiling fan.

L. S. STARRETT, Athol, Mass., sends us a copy of his 1894 catalogue of fine mechanical tools, to which a number of additions have been made, including new squares, gauges, milling cutters, a speed indicator and several others. The catalogue is well illustrated and should be on file in every workshop.

THE GENERAL ELECTRIC COMPANY, through its Southern office, has recently sold the following: Quitman, Ga., a 50-light arc and a 500-light alternator; Griffin, Ga., a 1,000-light alternator; Thomasville, Ga., a 1,000-light alternator; Selma, Ala., a 50-light arc; Courtland Manufacturing Company, Seneca, S. C., an 800-light incandescent plant; Lanett Cotton Mills, West Pond, Ga., a 900-light plant.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., has received an order from the Calumet and Hecla Mining Company for a new iron building, to be 40 feet wide and 125 feet long and covered on the roof and sides with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. Also an order from the E. W. Bliss Company, Brooklyn, for the iron work of a foundry extension.

THE ELSON AND BREWSTER ENGINEERING COMPANY, who are the New York representatives of the W. S. Hill Electric Company, of Boston, are obliged for the second time within a year to move into larger quarters, and can now be found at 143 Liberty street, where, with better facilities and a larger stock, they will be better prepared than ever to take care of their constantly increasing trade.

THE VIADUCT ELECTRICAL MANUFACTURING COMPANY, of Baltimore, manufacturers of telephone appliances, bells, etc., is as busy as nailers. A visit to this company's factory would convince any one of the activity existing in the telephone supply business. One of the many orders just booked by this company is that of 1,900 district telephone messenger call boxes of its own design, with all the appurtenances thereto for the City of Mexico.

THE GOUBERT MANUFACTURING COMPANY have removed from 32 Cortlandt street, New York, where they have been located for many years, and now occupy more commodious headquarters at 14-16 Church street, corner of Cortlandt. The new offices are attractive in appearance, and in their arrangement and furnishing offer every convenience for taking care of the large business done by the company in the "Goubert" feed water heater and "Stratton" separator, of which they are the sole manufacturers.

J. HOLT GATES, with headquarters at 1138 and 1140 Monadnock Building, Chicago, has become Western contractor for belted railway and lighting generators and motors of the Mather Electric Company, of Manchester, Conn. Mr. Gates is well known in the trade through his recent connection with the Siemens-Halske Electric Company and the Waddell-Entz Company, and has the reputation of being one of the most successful and energetic hustlers in the West, which argues well for the success of the re-organized Mather company's apparatus in that territory. Mr. Gates was working for the Mather Electric Company only one day when he sold two 500-light dynamos.

THE CHROME STEEL WORKS, of Brooklyn, N. Y., whose product is the well known Chrome cast steel, is a busy establishment. The abundance of orders which has kept these large works running full time with full number of hands during the past year, despite the lengthy period of general trade dullness, speaks volumes for the high favor which this material has obtained in this country. Chrome steel is very hard, tough and dense, will not deteriorate by the continued application of great heat, and can be worked successfully in large masses. These qualities adapt it especially for the manufacture of such castings as gears, wheels, pinions, hammer dies, etc., for general machine construction, and its use in this connection is extending rapidly.

THE SAFETY ELECTRIC BRAKE COMPANY, 30 River street, Chicago, Ill., has issued a prospectus calling attention to the features of its electric brake. A separate handle is not used with this brake, the mechanism of the controller being such as to apply the brakes and run the car with the same operating handle. Equipments are installed complete, replacing controllers now upon the dashers by simple and thoroughly well made controllers, including the full brake mechanism. Generally the old wiring upon the car body may be used throughout. The controller is furnished with thoroughly reliable reversing gear. The car is operated in either direction from either controller, and while operating in either direction the electric brake may be applied by the simple reversal or continuous movement of the single operating handle.

THE GENERAL ELECTRIC COMPANY has just closed a large contract with the Cataract Construction Company for the furnishing of about 2,000 h. p. of apparatus to be used in the plant of the Pittsburgh Reduction Company at Niagara Falls, the apparatus in question transforming the two phase current delivered from the station of the Cataract company at 2,500 volts into continuous current at 160 volts for the use of the reduction company. The plant of the Pittsburgh company is located at about 2,500 feet from the Cataract company. There will be furnished eight 200-kw. step-down transformers and four 370-kw. revolving transformers, for transforming two phase current into continuous current. It is believed that this will be the largest plant of the kind in the world, and the installation will mark an interesting step in the development of the use of multiphase currents for transmission purposes being again transformed into direct currents at the point of utilization. In addition to the apparatus above mentioned, the General company also furnishes the necessary switchboard and appliances to handle the same.

THE STANWOOD MANUFACTURING COMPANY, Chicago, has set apart a portion of its large factory at 17th and Clark streets for repair work, and has fully equipped it with all necessary machinery and appliances to carry on, in the best possible manner, this new departure. This company is now in a position to repair, on the shortest notice, everything electrical, from the largest dynamo or motor to the small and delicate testing instruments in daily use everywhere. The services of Mr. Earl Atkinson have been secured as superintendent. Mr. Atkinson has had an exhaustive experience in building and repairing electrical apparatus of all kinds. He began his mechanical career when 17 years of age, and after serving a number of years in the large machine shops of English & Humber, of Toronto, became connected with the Ball Electric Company, of the same city, and in 1888 entered the marine shops of the Delamater Iron Works, of New York City, where, in a short time, he became foreman. After the death of Mr. Delamater, Mr. Atkinson entered the laboratories of Thomas A. Edison, at Orange N. J., and soon became the head of the department there. Later on he went West, and until recently has been in the employ of the General Electric Company.

JOHN B. McCORMICK, the widely known turbine manufacturer, of Holyoke, Mass., has issued what is perhaps the most unique calendar that has appeared for many a year. On the upper part of the calendar is printed a well executed engraving entitled "An Allegory" (a copy of which appeared in our advertising columns on March 10, page xxi.), consisting of a central picture with a Greek architectural framing. The flanking columns are decorated with different forms of water wheels, turbines, and at the foot of one, a picture of a double turbine forming the body of a camel, below which is the following inscription: "A double hump discovered and exhumed in the vicinity of Keene, N. H. Supposed to have run away from the battlefield (at the Holyoke Water Power Company's testing flume), and chose as a hiding place the locality in which it was found." In the central picture the main figure is that of Hercules, with a turbine for a body, facing another turbine (the only one in propria persona), upheld by female personifications of science, mechanical genius and understanding, which he addresses in these words: "Behold! a greater than I is here." Surrounding Hercules are a number of dismembered dragons with turbine bodies and similarly constructed human and animal forms. Issuing from a mouthpiece attached to the triumphant turbine is the following: "I was conceived and brought forth by Thought, born of Wisdom, and was guided through adversity and along the dark paths of ignorance and superstition by Understanding, assisted by Science and the cultured head of Mechanical Genius. I am here to assist in interring the old, and prepare for the welcoming of the new—the twentieth century. I will grind a parchment from the trees of the forest, that Truths may be recorded thereon. I will create electrical forces to carry them to the uttermost ends of the earth, that the veil of ignorance may be lifted, never again to be let down. I will cause the busy wheels of industry to revolve more rapidly, that the burdens may be lifted from the poor and oppressed, and thus assist in fulfilling the prophecies of the great Victor Hugo." Owners and users of water power should procure a copy of this remarkable production for their offices.

WESTINGHOUSE, CHURCH, KERR & CO. have removed their offices from No. 17 Cortlandt street, where they have been for ten years, to the Havemeyer Building, No. 26 Cortlandt street. Although only ten years old this firm is now recognized as "an old established house." It may be said that there is scarcely another firm of just the same kind, for they are not agents, although selling the products of others; they are not exactly manufacturers, although owning and operating shops covering ten acres of ground in Chicago; they are not precisely consulting engineers, although consulted by a large clientage; they cannot properly be styled contractors, although constantly executing important contract work. They are rather a kind of their own making, wherein professional engineering, consulting, manufacturing and contracting, and especially the developing of new things are combined, and they claim that this idea is original with them. The general plan of the company seems to be the development of one thing at a time, and when that is in condition to need no further attention, its manufacture and sale are conducted through or-

dinary channels, and another new product is taken up. Among the various undertakings which have been successfully developed by the company are the Westinghouse engine, invented by Mr. H. H. Westinghouse and built by the Westinghouse Machine Company, for the perfection of which Westinghouse, Church, Kerr & Co. are responsible. They were also among the earliest and strongest advocates of subdivided power. In the change from simple to compound engines some years ago, they claimed to have had some hundreds of compound engines sold and in operation before other engine builders were fairly alive to the demand. In the mechanical stoking of coal they were also early in the field, and have been leaders in its development. The utilization of mechanical exhaust draft was another thing which they early took up, and which has been thoroughly developed in their hands. The steam loop is still another evidence of their foresight. The latest special subject which they have taken in hand is refrigeration and icemaking. They have an excellent and simple form of compressor and condenser, and have introduced various improvements in the methods of construction of refrigerating plants, and have perfected a new and radical process of manufacturing artificial ice. Throughout the financial depression of the past six months or more, Westinghouse, Church, Kerr & Co. have been one of the few firms that have held a substantial trade, which is due in part to their business methods, and in part to their diversity of interests. Their new offices consist of a suite of four large rooms and private hall on the sixth floor of the Havemeyer Building, and they are to be congratulated upon their larger and better accommodations.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED MARCH 6, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

515,751. ELECTRIC SWITCH SIGNAL; T. L. and N. W. Dalton, Sandy Hill, N. Y. Application filed Aug. 5, 1893. The combination of a signal circuit and a trolley circuit, of a forked contact piece between the same and a trolley contact, one of the circuits lying in the crotch of the fork, whereby the trolley wire is moved in contact with the signal wire and the signal operated.

515,755. ELECTRIC MOTOR; G. S. Bunn, New York, N. Y. Application filed July 29, 1893. A dynamo or motor having a field magnet so mounted that it can approach and recede from the armature, and a brake for the armature controlled by such movements of the field magnet.

515,761. SYSTEM FOR SIGNALING AND COMMUNICATION; T. F. Gaynor, Louisville, Ky. Application filed Dec. 30, 1891. The combination with a circuit having a call box mechanism, of an armature mechanism adapted to actuate a combined stamp and answer back mechanism.

515,762. ELECTRIC SIGNAL BOX; T. F. Gaynor, Louisville, Ky. Application filed Feb. 4, 1892. The combination of a shaft having a series of signal wheels loosely and rotatably mounted thereon, and separate keys fitted to the shaft and signal wheels for rotating them.

515,778. ELECTRIC METAL WORKING; H. Lemp, Lynn, and W. S. Moody, Chelsea, Mass. Application filed May 26, 1891. The combination with a secondary bar or conductor, of two adjustable contacts in electrical connection with an intermediate part of the bar, and adapted to bear upon the work placed between the terminals of the secondary.

515,779. STRAIN INSULATOR; H. H. Luscomb, Hartford, Conn. Application filed Nov. 4, 1893. An insulator consisting of a pair of eyes having integral shanks, bearing washers of laminated insulating material, and enlarged heads integral with the shanks, but insulated from each other, and a sectional metallic drum surrounding the enlarged heads and the washers on the shanks.

515,797. TELEPHONE RECEIVER; C. Selden, Baltimore, Md. Application filed Dec. 10, 1889. The combination of a diaphragm and two or more magnets, the pole ends of which are disposed near the diaphragm, the magnets being connected and placed in circuits, forming links in a chain of induction.

515,806. ELECTRIC LIGHTING SYSTEM; H. J. Wells, Osceola Mills, Pa. Application filed Aug. 20, 1892. The combination of a single rotary shaft having separate pulsators mounted thereon, contacts leading current from the generator to each pulsator, constant pole transmitters mounted on the shaft on each side of the pulsators, the transmitters being connected with separate contacts of the pulsators, and separate working circuits connected to the transmitters.

515,822. ELECTRIC CABLE; T. J. Dewees, Palmyra, N. J. Application filed Dec. 15, 1893. An insulated electric conductor having a moisture absorbing material, such as lime, applied to its insulating covering.

515,827. WATER ALARM FOR BOILERS; C. A. Hatch, Hartford, Conn. Application filed March 23, 1893. In a water alarm, the combination of baskets depending from a lever, and a float or buoy located between the baskets and adapted to sound an alarm or close an electric alarm circuit as the float is raised or lowered.

515,845. TELEGRAPH REPEATER; W. E. Sloan, Chicago, Ill. Application filed July 14, 1893. This comprises two electromagnets and armatures therefor, the movements of which operate to open and close main and local circuits, each magnet being provided with two sets of coils, both of which are in the main circuit when the latter is closed, and only one of which is in circuit with the local battery when the main circuit is open.

515,850. ELECTRIC ARC LAMP; J. J. Wood, Fort Wayne, Ind. Application filed June 7, 1893. The combination with an armature and armature lever of a strip of conducting material arranged to conduct the current between the armature and lever, and a spring plate overlying the strip and serving to press it into conductive contact with the armature lever.

515,882. DYNAMO ELECTRIC MACHINE; J. E. Maynadier, Taunton, Mass. Application filed Aug. 30, 1893. This comprises a plurality of field magnets, shafts and ring conductors, belt conductors connecting one edge of each ring conductor to one shaft with a ring conductor on the other shaft; and conductors connecting the other edge of each ring conductor with a ring conductor on the same shaft.

515,885. ELECTRICAL TRANSMISSION OF POWER; C. F. Scott, Pittsburgh, Pa. Application filed March 27, 1893. A main generator, a motor generator driven thereby, and a circuit fed by the latter, in combination with a supplementary generator, the field magnet strength of which is controlled by the current from the motor generator, and the electromotive force of which is added to that of the main generator.

515,900. ALTERNATING CURRENT MOTOR; C. E. L. Brown, Baden, Switzerland. Application filed June 13, 1893. A non-synchronous alternating current motor, having its induced winding provided with a collector and brushes connected and adjusted to produce poles in the induced winding, the position and action of which poles produce a turning moment and start the motor, and means for producing the short circuiting of the induced winding, after the motor has attained its normal speed.

515,905. SPLICE COVERING FOR ELECTRIC WIRES; T. J. Dewees, Palmyra, N. J. Application filed July 25, 1891. A tubular sheath of paper having an internal diameter substantially equal to that of the twisted joint of the wires, and supported at its middle directly by the twisted joint, and at its ends by the insulation of the two wires.

515,907. HANGER FOR TROLLEY WIRES; G. Forbus, Williamsport, Conn. Application filed September 6, 1893. The combination with two plates, of teeth or projections on the inner faces thereof.

515,939. TELEPHONE EXCHANGE SYSTEM; E. Pope, Quebec, Canada. Application filed Aug. 3, 1892. The combination with a subscriber's circuit, of a test battery normally in connection therewith and mechanism controlled by the subscriber for breaking the connection with the test battery.

515,971. PORTABLE REGULATOR FOR ELECTRIC CURRENTS; E. E. Ries, Baltimore, Md. Application filed April 4, 1893. This comprises means for graduating the flow of current, a plug adapted to incandescent lamp sockets, and connection for coupling the current graduating devices to a translating device.

515,977. ALTERNATE CURRENT MOTOR; W. Stanley, Jr., J. F. Kelly and C. C. Chesney, Pittsfield, Mass. Application filed April 1, 1893. The method of operating electric motors, having independent field magnets and mechanically connected armatures, the coils of which are connected together in closed circuit, which consists in setting the poles of one field at an angle to those of the other, and directing through the two fields respectively alternating currents of different phase, and then when the motor is brought to speed, turning the poles of the two fields into alignment and directing through both alternating currents of the same phase.

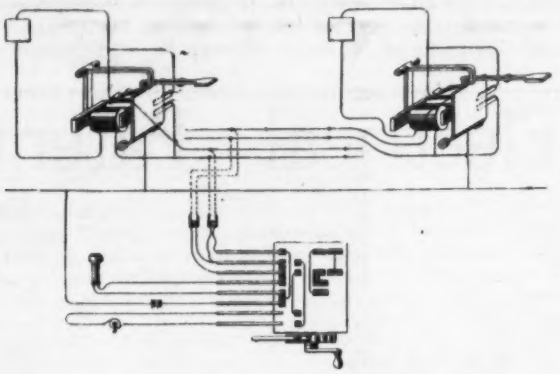
516,025. ELECTRIC CIRCUIT BREAKER; D. S. Schureman, Rockford, Ill. Application filed July 19, 1893. This consists of a frame gear supported in a frame, having a pivotal connection with a stationary support, an armature holding the frame stationary, an electromagnet when energized causing the armature to release the frame, and an electric connection with the frame, which is changed after the frame has been released.

515,940. TELEPHONE SYSTEM; E. Pope, Quebec, Canada, Ap-

plication filed Sept. 2, 1892. The combination with the subscribers' circuits of separate test wires normally without battery connections, respectively therefor, two sources of current under control of an operator, and means for connecting said sources of current respectively with the test wires of any two subscribers' circuits.

515,960. AUTOMATIC CUT-OUT FOR INCANDESCENT LAMPS; E. H. Johnson, New York, N. Y. Application filed May 17, 1886. A separate switch, composed of two wires located in soldering proximity and bridged by an arc inducing material, which is normally an insulator, but which, by heat, is reduced to a conducting state, in combination with separable circuit connections.

515,962. ALTERNATING CURRENT MOTOR; J. F. Kelly, Pittsfield, Mass. Application filed March 27, 1893. The method of



NO. 515,939.—TELEPHONE EXCHANGE SYSTEM.

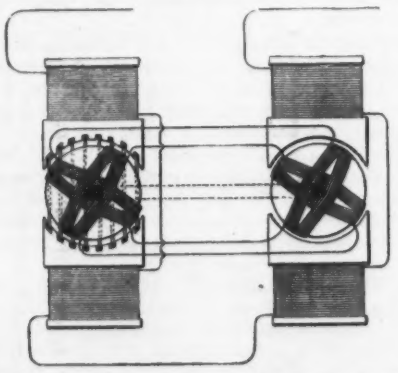
operating motors having independent fields and rigidly connected armatures, which consists in energizing the fields simultaneously by alternating currents of the same phase, and energizing the armatures by alternating currents of different value. (See illustration.)

515,969. REGULATING SOCKET FOR ELECTRICAL APPARATUS; E. E. Ries, Baltimore, Md. Application filed Jan. 24, 1893. A reaction coil and a holder for the same, composed of two blocks of refractory material, clamped together and to the reaction coil by the shell of the socket.

515,970. ELECTRIC CURRENT REGULATOR; E. E. Ries, Baltimore, Md. Application filed Feb. 2, 1893. A rheostat, consisting of a carbon helix, having convolutions of gradually increasing thicknes, and means for compressing the helix and thereby short circuiting the convolutions upon each other by insensible degrees. (See illustration.)

516,038. AUTOMATIC SWITCH FOR STORAGE BATTERY USE; T. A. Willard, Norwalk, Ohio. Application filed July 1, 1893. The combination of a shunt wound magnet in combination with its armature, provided with poles and wound with coils in series with the main circuit, an armature lever supporting the armature, contact point adapted to close the main circuit when the magnet attracts the armature, and a spring adjustment therefor.

516,043. THERMOSTAT; E. Barney, Schnectady, N. Y. Appli-



NO. 515,962.—ALTERNATING CURRENT MOTOR.

cation filed Sept. 20, 1893. This comprises a conducting base having a post mounted in a box thereon, a blade secured to the post, formed of materials of differing expansibility riveted together, posts insulated on the base, contact screws mounted horizontally in the posts and extending opposite the free end of the blade, binding screws insulated on the base and connected with the contact posts, and a third binding post on the base and in electrical contact therewith.

516,071. ELECTRIC HEATING APPARATUS; A. E. Appleyard, Boston, Mass. Application filed Jan. 16, 1893. This comprises a core externally coated with an insulating material, and provided with a continuous seamless, electrically deposited metallic shell covering and extending over the ends of the core.

516,095. ELECTRIC RADIATOR; S. B. Jenkins, Boston, Mass. Application filed March 29, 1893. A series of removable sections, each provided with an interrupted flange, or row of cores, in combination with electric heating devices applied to the said cores, and fastening and supporting devices for the sections.

516,152. ELECTRICAL HEATER; A. Cochrane, Lowell, Mass. Application filed Jan. 6, 1893. The combination of a tube, covered externally with a non-conductor of heat and electricity, a helix wire of high resistance, a perforated tube inclosing the helix and tube, but of such diameter that there is a space formed between the outer and inner tubes, and ring shaped heads in which the ends of the tubes are secured.

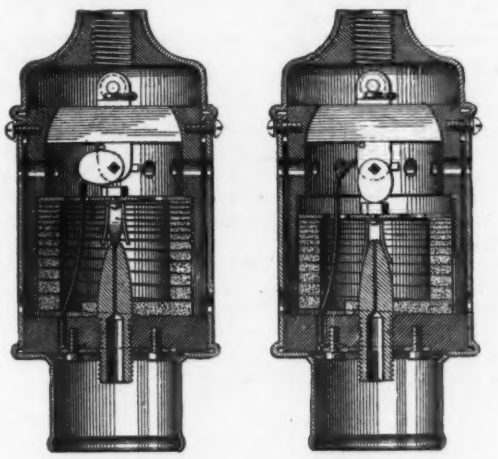
516,161. ELECTRIC CABLE JOINT; T. C. Loe, New York, N. Y. Application filed Aug. 14, 1893. A splice in an electric cable or similar flexible lead covered construction having protecting sleeves applied about the cables at the joint, and extending outside the joint.

516,167. APPARATUS FOR GENERATING STEAM BY ELECTRICITY; H. E. Rider and J. H. Lewis, New York, N. Y. Application filed Feb. 17, 1893. An electric heater, consisting of an electric conductor of sufficiently high resistance to develop heat on the passage of a suitable electric current therethrough, an insulator surrounding said conductor, and a wrapped covering wound upon the insulator.

516,170. ARMATURE FOR DYNAMO ELECTRIC MACHINES; M. Waddell and J. B. Entz, Bridgeport, Conn. Application filed May 13, 1893. In an armature, the combination of a spider of magnetic metal and a fastening of non-magnetic metal united thereto.

EXPIRED FEB. 20, 1894.

187,674. CIRCUIT CLOSER FOR BURGLAR ALARMS; W. H. Sawyer, Philadelphia, Pa. Filed Jan. 16, 1877. The combina-



NO. 515,970.—ELECTRIC CURRENT REGULATOR.

tion of a case, spring, insulators and valve seated contacts.

EXPIRED MARCH 6, 1894.

188,163. COUPLINGS FOR RAILROAD TRAIN TELEGRAPHS; E. J. McRavey, F. W. McRavey and J. Schwartz, Milwaukee, Wis. Filed April 13, 1876. A coupling consisting of two parts, each constructed of two springs, separated by an insulating portion running diagonally between them.

188,179. FIRE ALARM TELEGRAPH REPEATERS; C. H. Pond, Jackson, Miss. Filed Feb. 26, 1877. A transmitter actuated by a local battery in combination with main line magnets, the transmitter being controlled by the local points of the loop in which the circuit is first interrupted.

188,180. FIRE ALARM TELEGRAPH SIGNAL BOXES; C. H. Jackson, Miss. Filed Feb. 26, 1877. A signal box having a vertically moving circuit bar dropped by gravity when its containing box is opened, to a position for signaling and raised by a spring driven train to signal.

188,181. FIRE ALARM TELEGRAPH REPEATERS; C. H. Pond, Jackson, Miss. Filed Feb. 19, 1877. A mercury tube acting to close the circuit immediately after it is broken, thus putting the apparatus in condition to respond to the next break.

188,182. SIGNAL BOXES FOR FIRE ALARM TELEGRAPHS; C. H. Pond, Jackson, Miss. Filed Feb. 19, 1877. A detent for releasing an alarm train held in position by a hook, a rack bar released from the gear by a pinion, and a secondary train falling by gravity whenever the main line circuit is broken by the operation of any box.

188,183. BELL STRIKERS FOR FIRE ALARM TELEGRAPHS; C. H. Pond, Jackson, Miss. Filed Jan. 4, 1877. A tripping device for operating valve mechanism of a single pneumatic engine, the piston rod of which operates the bell hammer.